THE ILLUSTRATED STORY OF EVOLUTION

Marshall J. Gauvin

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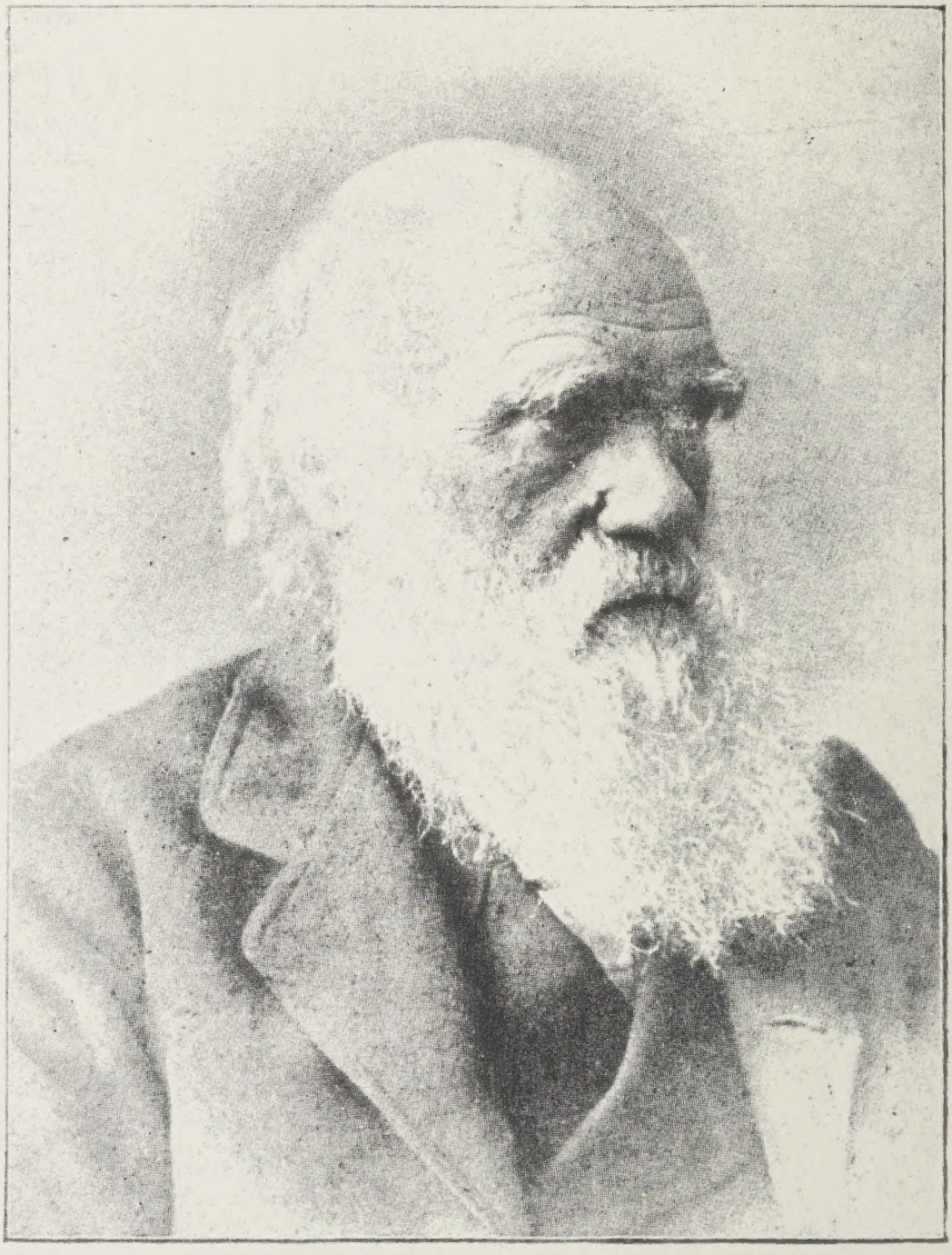

CHARLES DARWIN

The Illustrated Story of Evolution

BY

Marshall J. Gauvin

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"Is There a Real God?", "Is There a Life After Death?" etc.

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TO MY WIFE

Whose fine literary taste applauds the slightest beauty of a phrase, and whose interest in this book was helpful in its preparation.

Introduction

The Greek philosophers from Thales to Aristotle, more than two thousand years ago, entertained the notion that all things have been developed from primitive beginnings. This view was shared in the fourth century of the Christian era by St. Augustine, probably the greatest of the church "Fathers." Then came the Dark Age,—an intellectual night of a thousand years—an era when reason and science were buried in the grave of superstition,—and at its close, the Revival of Learning, the dawn of the modern period.

In that golden Renaissance of rational thought and scientific speculation, philosophical thinkers —Bruno. Campanella and others—influenced by the theories of the Greeks and by the astronomical discoveries of Kepler, Copernicus and Galileo, sought to explain the universe as an unfoldment from a simple, early condition of matter. But such speculation was denounced as

dangerous, and Bruno died a martyr in the flames. Still the idea that there has been an evolution in nature persisted and grew, and the writings of Spinoza in Holland, of Locke in England, of Kant in Germany, of Lamarck in France,—to mention but a few philosophers—encouraged men to think that the secret of existence lay in the fact of growth.

Then came the greatest of books on the development of living things. In 1859, Darwin gave the world his "Origin of Species," a work which laid the foundation of the science of evolution. Earlier thinkers had groped and guessed with little knowledge of Nature's laws. But Darwin had discovered the laws of organic life, and, with an amazing array of evidential facts patiently observed and gathered in a score of years, he was able to support his view that species have been evolved "by means of natural selection" through "the preservation or favored races in the struggle of life."

In the interest of the six-days creation legend, a storm of theological wrath assailed the great man's head. Knowing that truth was on his side, the saint of science paid no heed to slander and patiently worked on. And in twenty-three years he wrought a greater, a more farreaching revolution in the thoughts of intelligent mankind than was ever accomplished by any other of the sons of men; and when he died, England was glad to

honor his dust with burial in her sacred Westminster Abbey.

Evolution is as firmly established to-day as the fact of gravitation. The intellect of the whole world acclaims it as the one and only principle that explains the phenomena of existence. True it is, that many naturalists disagree with Darwin with respect to some of the details of the *process* by which evolution has been brought about, but these men are one and all thoroughgoing evolutionists. There is no man of science living who believes in special creation. Every university now teaches evolution.

Every science studies its facts to-day, in the light of growth and change from simplicity to complexity. The astronomer traces the course of evolution in the heavens; the geologist follows the path of evolution in the crust of the earth; the biologist threads the process of growth though succeeding forms of life; the psychologist considers the gradual emergence of mind from the lowly animal to civilized man; the sociologist elucidates the progressive development of society from its rude barbaric dawn; the inquiries of the anthropologist illuminate the evolution of religion, of government, of law. Every phase of existence and life and thought opens its treasury of secrets when touched by evolution's master key. Where all the facts point resistlessly to one conclusion, that conclusion must perforce be accepted

as true. The foundations of evolution are laid in all the active phenomena of nature and the superstructure is being fashioned by all the facts of growth and change.

The purpose of this little book is to set before the busy reader some of the principal facts illustrating the evolution of the universe and of living things.

MARSHALL J. GAUVIN

Pittsburgh, Pa., August 30, 1921.

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The Illustrated Story of Evolution

Our fathers, many ages ago, looked out upon the world with mingled feelings of reverence and fear. They saw the sun that dazzled their eyes with the brightness of his beams as he flamed his way across the path of day; they saw the white light of the moon, hung like a spirit lamp amid the clouds that sailed over the face of night; they saw the stars, now spangling the darkness with the glory of their sheen, now veiling their faces with the sable void; they saw the infinite variety of plants, the animals of every size and form; they saw man himself, the master of the earth; and they would know something of the mighty scheme. They did not dream of natural law, but they were curious. Destitute of science, they were full of wonder. What could be the driving power back of what they saw? Existence was a challenge. They must essay an explanation. Their minds refused to rest content in ignorance. They must know how things came to be.

It was the age of gods. Gods were in the wind

and rain, in the flood and flame, in the roar of the thunder and the echo of the forest gorge, in the harvest that sustained and the disease that destroyed—in everything that helped or hurt the sons of men. Man could do things; the gods could do things too. Man could build a home; the gods could build a world. So reasoned our primitive fathers. Of this reasoning were born the creation stories of the ancient religions; and these stories, coming down to our day, have fixed the beliefs of countless generations of men.

In one of these creation myths, regarded as of divine authority because it is found in the Bible, we are naively told that the world with its myriad forms of life and the star-studded universe beyond, were created in six days; and as this childish story is inseparably interwoven with popular religious notions, millions still regard it as sacredly true.

But this is an age of science, of a growing knowledge of reality. During the last few generations, the facts of nature have been studied as they never were studied before. As a result of this study, nature has yielded to man's inquiring mind a growing knowledge of her methods. This knowledge is now accepted by the educated world as the science of evolution.

We can imagine only two ways by which the world and its forms of life came into existence. One is to suppose that all things were created out

FIG. 1.—THE GREAT NEBULA IN ORION.

This illustration and the four that follow are reprinted from Sir Robert Stawell Ball's "The Earth's Beginning," with acknowledgments to Cassel & Co., London, and D. Appleton & Co., New York.

of nothing, and made perfect at once, by a being of infinite power and intelligence who never had beginning. That is the biblical, the miraculous, the supernatural way. The other is to suppose that the raw material always existed, and that all things have been developed from primitive origins, the higher forms gradually emerging by evolution out of the lower. That is the scientific, the natural way. The first view is an assumption utterly devoid of support. The evidence proves that nothing was made, that things have grown.

Not only do we know that a creating God is a mere guess; that he is unthinkable in quantity or quality, that he bears no conceivable mark of reality; not only do we know that the creation of a universe out of nothing is wholly unintelligible; but the evidence of astronomy points clearly to the conclusion that our planet has been evolved by condensation from a nebula—from the raw material of which worlds are made; the evidence of geology portrays the fact that the earth has become what it is through a process of continuous change covering many millions of years; and the evidence of botany and of biology, studied in living forms and in fossil remains, proves conclusively that the plants and animals of the world have acquired their present character and mould as a result of infinite variations from and improvements upon the first simple forms of life that arose in the primeval world.

FIG. 2.—THE GREAT SPIRAL NEBULA.

Not creation, then, but evolution, is the secret of the world's infinite diversity of things. Nothing was made; everything has grown. Perfection is not at the beginning, but at the end of nature's efforts. All things have been fashioned by a process of endless transformation—blind, boundless, staggering, stumbling—at times falling back, but on the whole moving forward, pressed by the relentless forces inherent in substance and shaped in accordance with immutable law. Such a process has covered the earth with its amazing display of vegetation, and with its strange and wondrous population of things that swim and creep and fly and run.

In sketching the story of evolution, as that story is revealed to us by science, let us begin with the evolution of the starry heavens, that we may learn how the world was born.

As the giant telescope sweeps the abysmal depths of space over a distance of at least 4,000 billion miles, it reveals here and there among the hundred million stars, vast patches of cloud-like material. This material is called nebula, and it is the original substance of which all suns and planets are made. One hundred and twenty thousand of these nebulæ come within the range of the great Crossley Reflector at the Lick Observatory. The telescope photographs the nebula —celestial photography is one of the most interesting and instructive branches of modern astron-

FIG. 3.—AN ELONGATED IRREGULAR NEBULA.

omy—and when you look at a picture of a nebula, you see an actual photograph of an object that marks the beginning of Nature's work.

According to Sir Robert Stawell Ball, the nebula in Orion (Fig. 1), one of the most beautiful objects revealed by the telescope, covers an area more than a million times larger than that occupied by our entire solar system. Many of the nebulæ are of the spiral form, which shows their whirling motion. To the astronomer, the Great Spiral Nebula (Fig. 2) represents a mighty sun and system of planets in process of formation. Fig. 3 shows an elongated, irregular nebula, from the Constellation Cygnus. This sketchy streak of nebulous material, although it is still many millions of miles wide, is but the remaining thread of a once mighty nebula that has condensed and is still condensing into the surrounding stars.

The nebulæ represent various stages of evolution into suns and worlds. Some resemble great clouds of rarified matter; some are distinctly spiral in form; some show advanced condensation into stars with attendant planetary systems. The stars, too, exhibit various degrees of progress from their birth in the nebula. Some are white, which shows that they are young; some are yellow, which indicates that they have reached middle age; some are red, which is the mark of their declining years.

So the stars, the glowing suns, grow old and

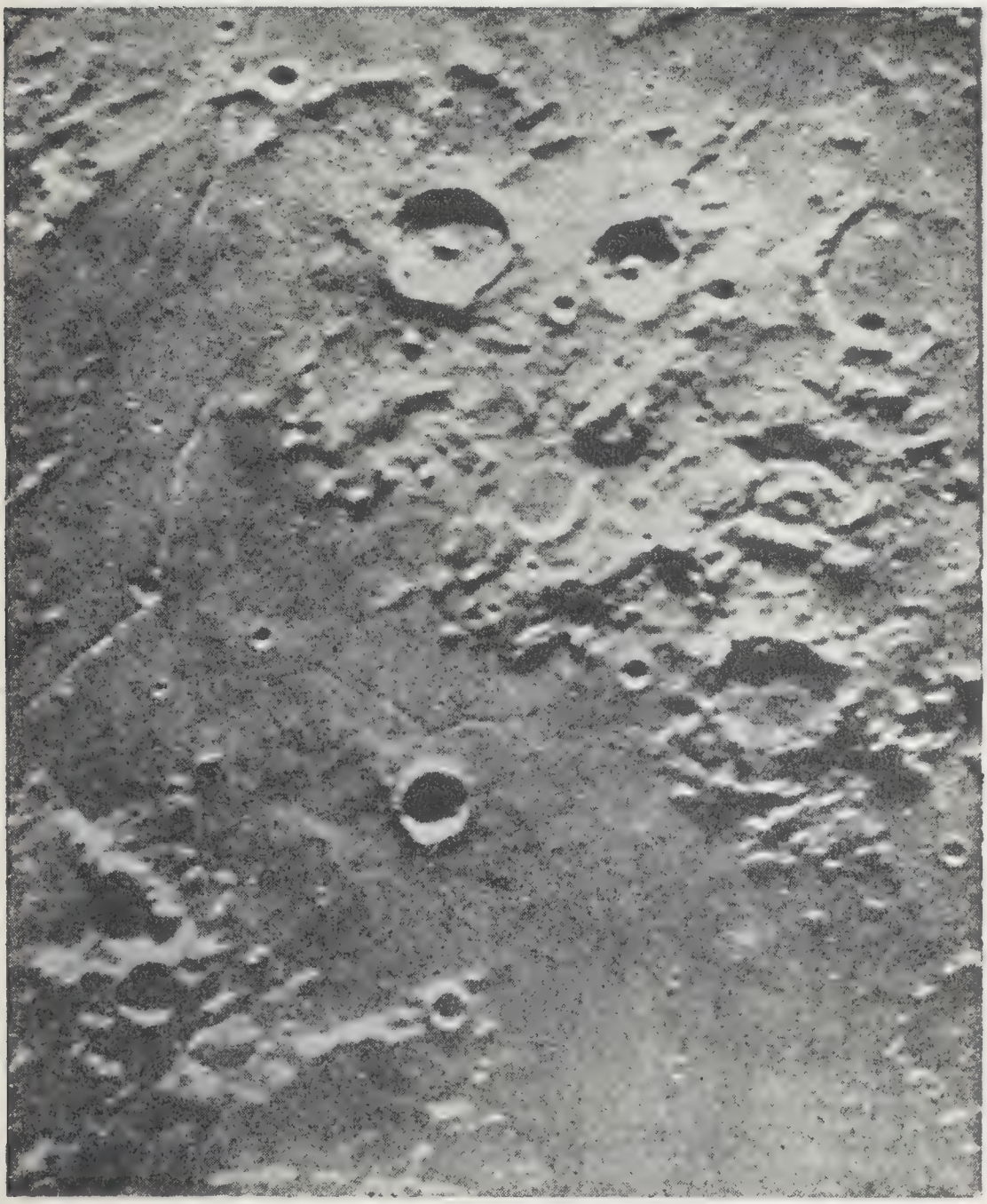

FIG. 4.—LUNAR CRATERS: HYGINUS AND ALBATEGNIUS.

die, and, lifeless, wheel in space, like mighty cinders cold and dark, reflecting, like the moon, the light that shines on them from brilliant orbs.

The moon (Fig. 4) is a dead star. Its light and heat are gone. It wheels in space, an extinct cinder, and by the borrowed light which enables us to see the craters on its surface, it prophesies for us the fate that one day will overtake the earth. But that will be millions of years from now; so we need not worry!

But how is the nebula formed? The cluster in the constellation Hercules (Fig. 5), if it is not in fact a colossal nebula, shows that some of the stars are very close together. Now, these immense objects, that in blind fury dash through space, may come into collision with one another and explode into a nebulous cloud; or they may plough through dense swarms of meteorites, with a resultant explosion on a smaller scale; or, torn by internal convulsions, they may burst into fragments and scatter their dead dust over the abyss of space. In one or all of these ways the nebula is born, to begin again the recurring cycle of Nature's life.

Is there further evidence of this? There is. On the night of February 21, in the year 1901, a luminous object appeared in the constellation Perseus. From a region where all was darkness the night before, a new and wondrous body now blazed forth its treasures of light. To the astron-

FIG. 5.—THE CLUSTER IN HERCULES.

omers, who with lively curiosity watched the new birth for months, it meant that a tremendous conflagration had taken place in the heavens. A new nebula had been given to the universe, not, however, on the night when its light was first seen, but when Napoleon was dazzling the world with his victories; for the glowing mass was 500 billion miles away, and its messenger light, flying across space with the awful velocity of 186,000 miles a second, had been hurrying ninety-nine years to bring the news to our world!

Science now warrants a further step—one which reveals the origin and nature of matter—the ultimate source of the nebula itself.

Ether fills all space. It penetrates even the most solid substances. The universe of matter swims in an ocean of ether. Only by the presence of ether is the force of gravitation made possible—it must have ether upon which to act. The wings of ether alone transmit to us the light of the sun and stars. Now science is telling us that this indispensable ether, this infinitely attenuated and invisible substance, is the birthplace of matter—that atoms of matter are composed of minute centres of energy, or electrons, in ether. The atom is built of thousands of electrons whirling with inconceivable velocity in the space of their tiny, invisible universe; just as the visible universe is composed of myriads of suns and planets rushing forward through the boundless etherial

GENERAL TABLE OF THE STRATIFIED SYSTEM AND FORMATIONS, Etc.

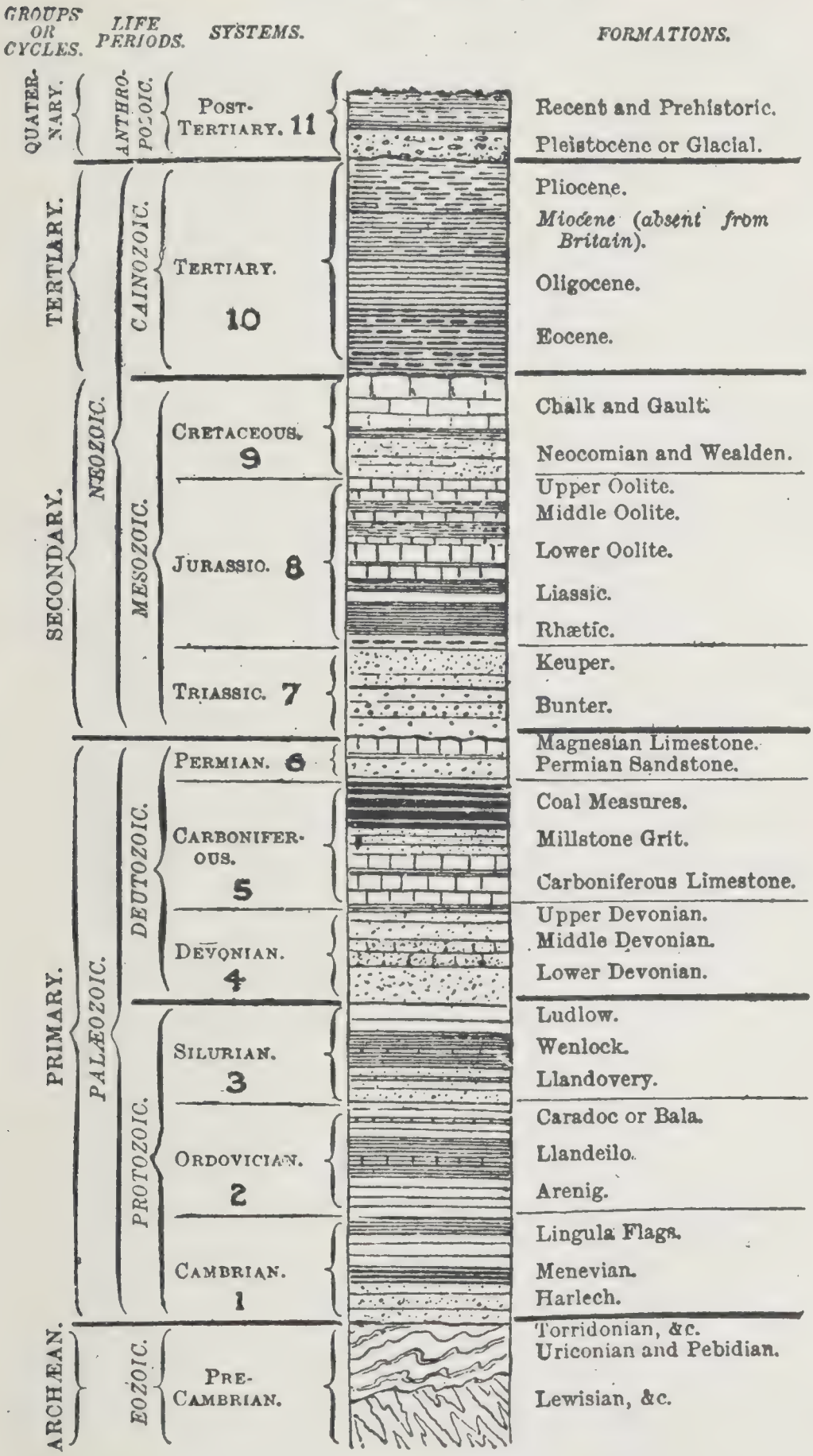

FIG. 6.—A PILLAR OF STRATIFIED ROCKS.

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ocean. Matter, then, whether nebulous or solid, was evolved out of the ether.

Millions of ages ago, a collision or an explosion produced a nebula in the region now occupied by our solar system. That nebula spread out over thousands of millions of miles of space. Here and there, in its mighty body, a more solid nucleus drew to itself volumes of the surrounding substance. In this manner the planets arose, leaving the sun, with his giant mass, in the center of the field. As the nebula revolved in one direction, mathematical necessity imparted to all the forming bodies a whirling motion around the central sphere. The smaller bodies cooled rapidly, so to speak, and crusted over; but the sun, owing to his immense bulk, has continued to glow through all these countless ages, and still sends forth enough light and heat to illuminate and warm many billions of worlds like ours. How long a time has elapsed since the earth began to condense from the nebula, the human mind cannot conceive; but Sir G. H. Darwin, the son of Charles Darwin, declares it is not unreasonable to suppose that from five hundred to a thousand million years have passed away since the moon was detached from the earth.

When the moon was born, the earth was in a plastic state, and many millions of years had yet to elapse before anything like a solid surface could begin to appear upon it. When, at length,

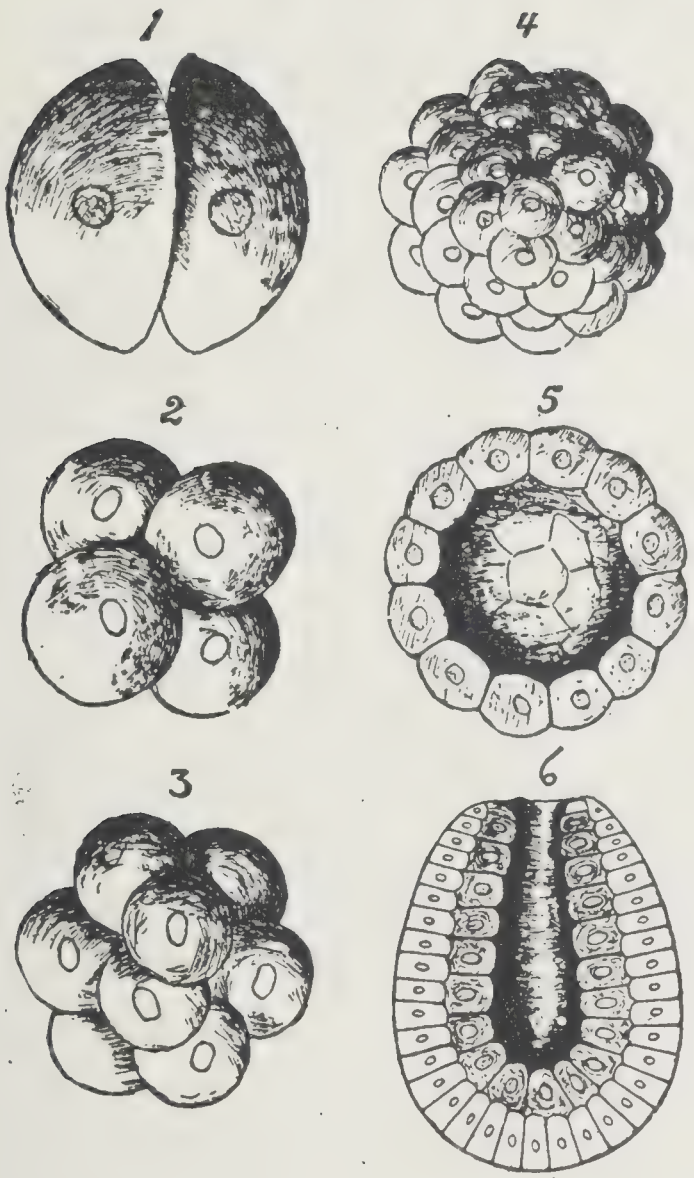

FIG. 7.—SEGMENTATION OF THE FERTILIZED OVUM AND GASTRULATION.

4, morula; 5, section through blastula showing hollow sphere; 6, gastrula showing outer layer of cells (epiblast) and inner layer (hypoblast); the 6 is at the mouth of the cavity (enteron) of the gastrula. From Dr. D. Kerfoot Shute's "A First Book in Organic Evolution," Courtesy of The Open Court Publishing Co.

the cooling globe did begin to form a crust, that crust was from time to time shattered to fragments by violent eruptions from within. Later, the immense quantities of hydrogen and oxygen that were in the atmosphere combined into molecules of water, and torrents of rain settled upon the hot surface of the earth. Owing to the large admixture of carbonic acid gas which it contained, the atmosphere was then fifty times heavier than it is to-day; but notwithstanding this great pressure upon it, the water that settled on the hot crust of the earth could not remain, and was sent, hissing, into the air in clouds of steam. The time came, however, when the cooling surface of the planet no longer offered such vigorous resistance to the water that fell upon it, and gradually as the rain fell, the earth became almost entirely covered with a boiling ocean. But the hot earth, even under the enormous weight of its ocean and its dense air, was restless, and as time passed away, great stretches of land emerged. Upon this new land, the rain now poured down in floods. This caused a great washing of debris into the surrounding sea. There the debris settled, and beneath the tremendous pressure of the ocean, it became solidified into the oldest stratified rocks.

The rock pillar (Fig. 6) represents the rock formation of the crust of the earth. It gives us an idea of what a cross-section of the earth's

FIG. 8.—CAMBRIAN FOSSILS (above); UPPER SILURIAN FOSSILS (below).

crust would look like, if all the rock deposits could be found superimposed one above the other in any one place. These rocks, built up layer upon layer, by sedimentary deposits in the ocean, are believed by geologists to reach a depth of more than forty miles; and it is held that it must have required at least a hundred million years—perhaps a thousand million years—to lay down all the strata, all the series of layers of rock, that form the crust of the globe.

That these immense depths of rock have been formed by a slow process of growth, of gradual up-building, is certain. The world was not made in a day. It has grown through innumerable ages. It is still growing. At the present time, the rivers of England are carrying away thousands of tons of land every year and depositing it on the floor of the sea. Every year the Mississippi river carries four hundred million tons of solid material into the Gulf of Mexico. This one stream alone displaces more than a million tons of solid matter every day. Similar things are occurring, in greater or less degree, in every part of the world. Everywhere rivers are widening and deepening their channels, cutting their way into mountains, depositing sediment for rock formations, or overflowing and fertilizing soil; everywhere mountains and hills are being worn down by the action of the elements; continents are crumbling into the ocean; island surfaces are

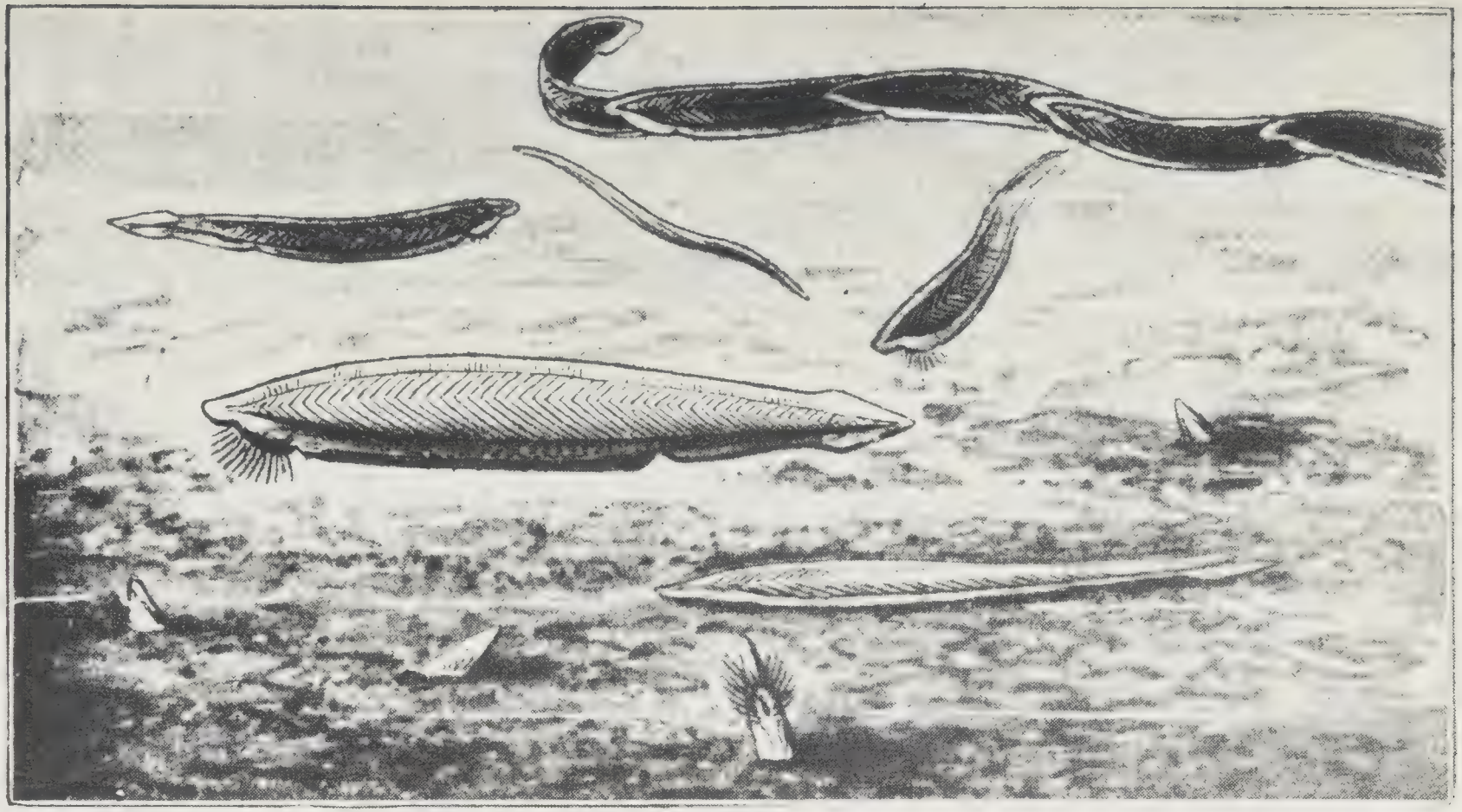

FIG. 9.—THE AMPHIOXUS.

This illustration and several others used in this book are reprinted from J. A. S. Watson's "Evolution." Courtesy of The Frederick A. Stokes Co.

rising above or falling beneath the waves. Nature is ever flowing. Throughout her infinite domain there is everlasting movement. Her trademark is eternal change. Nowhere is she at rest. Her labors never cease. To-day, as in the past, she builds and destroys. In her endless process of evolution, every day is a day of creation.

These rocks contain fossils, the skeletons of creatures that lived during the periods when the rocks were being formed. This fact is one of the keys to the temple of evolution; for when we know the kind of fossils the different rocks contain, as we rise from the lower to the higher, we know the kind of creatures that lived in the various periods when those rocks were formed. Let myth-makers say what they will, Nature does not lie.

As the crust of the earth cooled, the enveloping ocean gradually lost its high temperature, and having fallen far below the boiling point, continued to be warm for ages. In that warm primeval ocean, where the various elements entered into all sorts of combinations, the necessary elements combined in the proper proportions, and, as a result of that happy combination, life was born into the world. Just as the requisite proportions of charcoal, sulphur and saltpeter unite in making gunpowder—a high explosive, vastly different from its constituent elements—so, simple elements, uniting in due pro

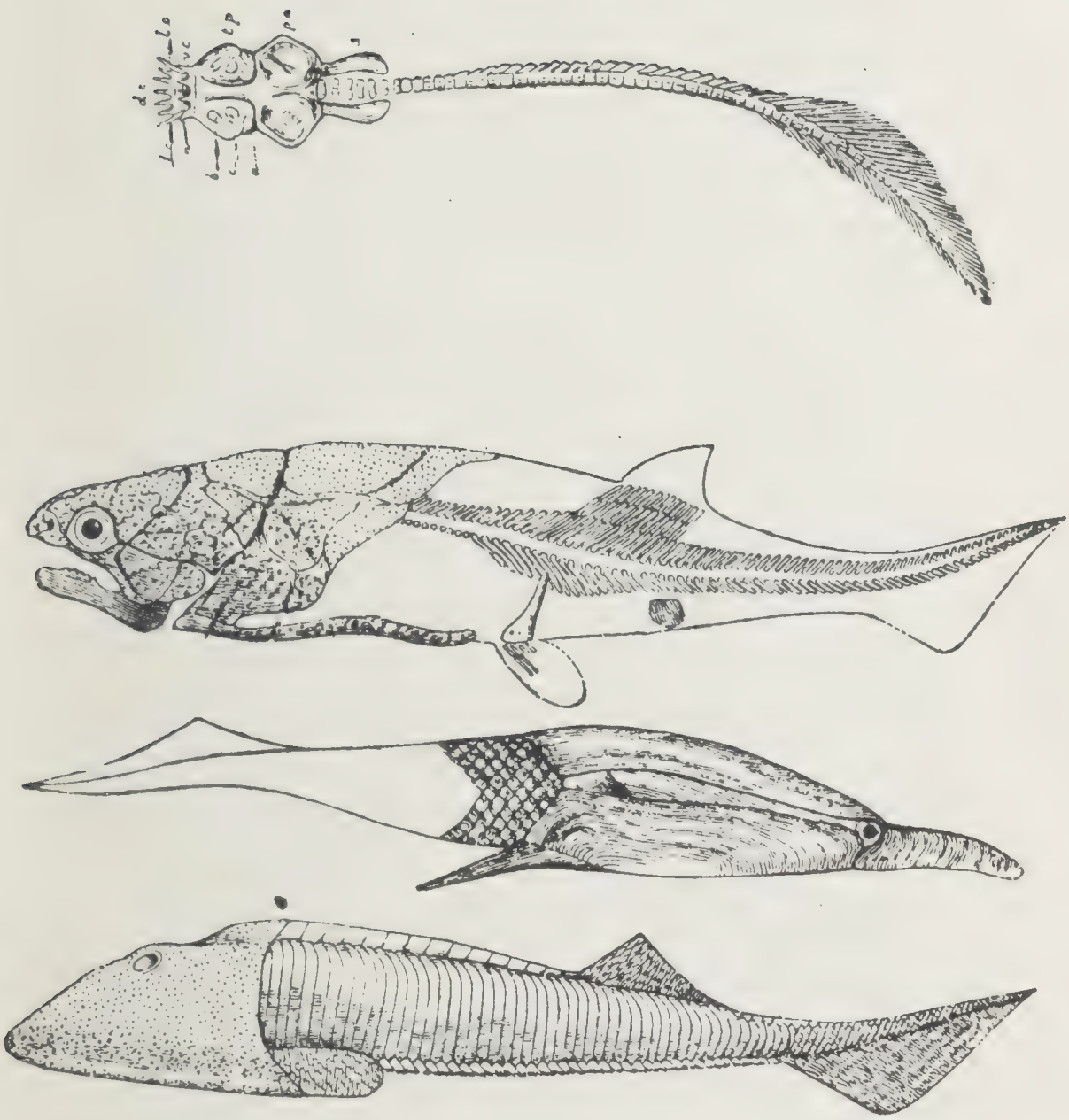

FIG. 10.—THE EARLIEST KNOWN FORM OF FISH (upper); THREE OTHER EARLY FORMS OF FISHES (lower).

portions, produced the phenomenon of living matter.

Whether life is still being evolved from non-living matter, or whether its origin was confined to a peculiar set of favorable conditions—very high temperature, and unusual chemical and electrical conditions—in the early world, remains as yet unknown. On this question, the most distinguished biologists entertain diverse opinions. Among those who hold that the evolution of life is still one of the ordinary processes of Nature's day's work may be mentioned Professor Benjamin Moore, F.R.S., whose views are set forth in his excellent little work, "The Origin and Nature of Life."

All living things, from the blade of grass to the giant oak, from the worm to the philosopher, are composed of cells, and all cells are composed of protoplasm. Protoplasm is, therefore, the physical basis of life. This wonderful substance is a compound of carbon, hydrogen, nitrogen and oxygen, and the story of the evolution of living things spells the limitless transformations of which this vital substance is capable.

In the world of to-day, we see the finished forms that have been beaten out, as it were, upon the anvil of the evolutionary process; and if we would appreciate the progressive march that life has made, from the simple forms of early days to the highly developed and complex creatures of

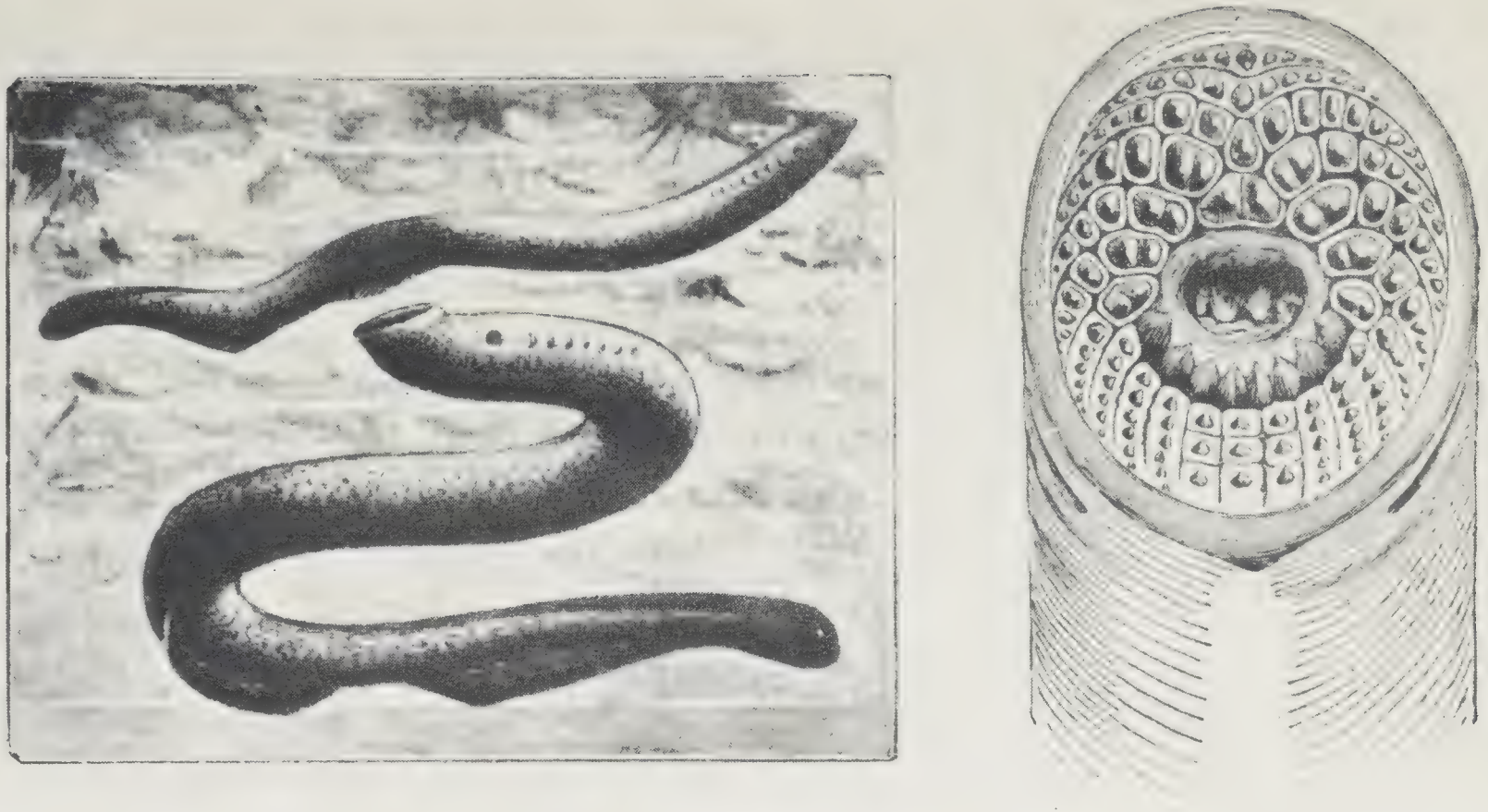

FIG. 11.—LAMPREYS (left). THE MOUTH OF A LAMPREY (right).

to-day, we must trace the story of evolution through the numberless ages of the past.

The first living things consisted of a single cell—the Protozoa. As this cell grew, it divided into two; the two, having grown somewhat, divided into four; the four into eight; the eight into sixteen, and so on. In this way, the growing cells increased their numbers by division, and what was at first a single cell became an organized group of cells. Fig. 7 illustrates the process of division and growth from the single cell—the fertilized ovum—to the gastrula. This division is the law of life. Every living creature begins its existence in this way.

Gradually, some cells specialized in the performance of the simplest animal functions, like the catching of food and digestion; and in the course of time, such simple forms of life as sponges and marine worms appeared. From flat worms, life advanced to the annelid or ringed worms—little creatures with a food canal and a body cavity filled with blood. In the worm begins the first development of the brain. A few sensitive cells in the fore end of the body, that beginning of mental life, is a far-flung prophecy of the genius that will one day thrill the world. Primitive depressions, lined with pigment cells, in the worm-like head, represent Nature's first reaching for eyes; two other sensitive nerve pits are the beginning of the nose; yet a further pair

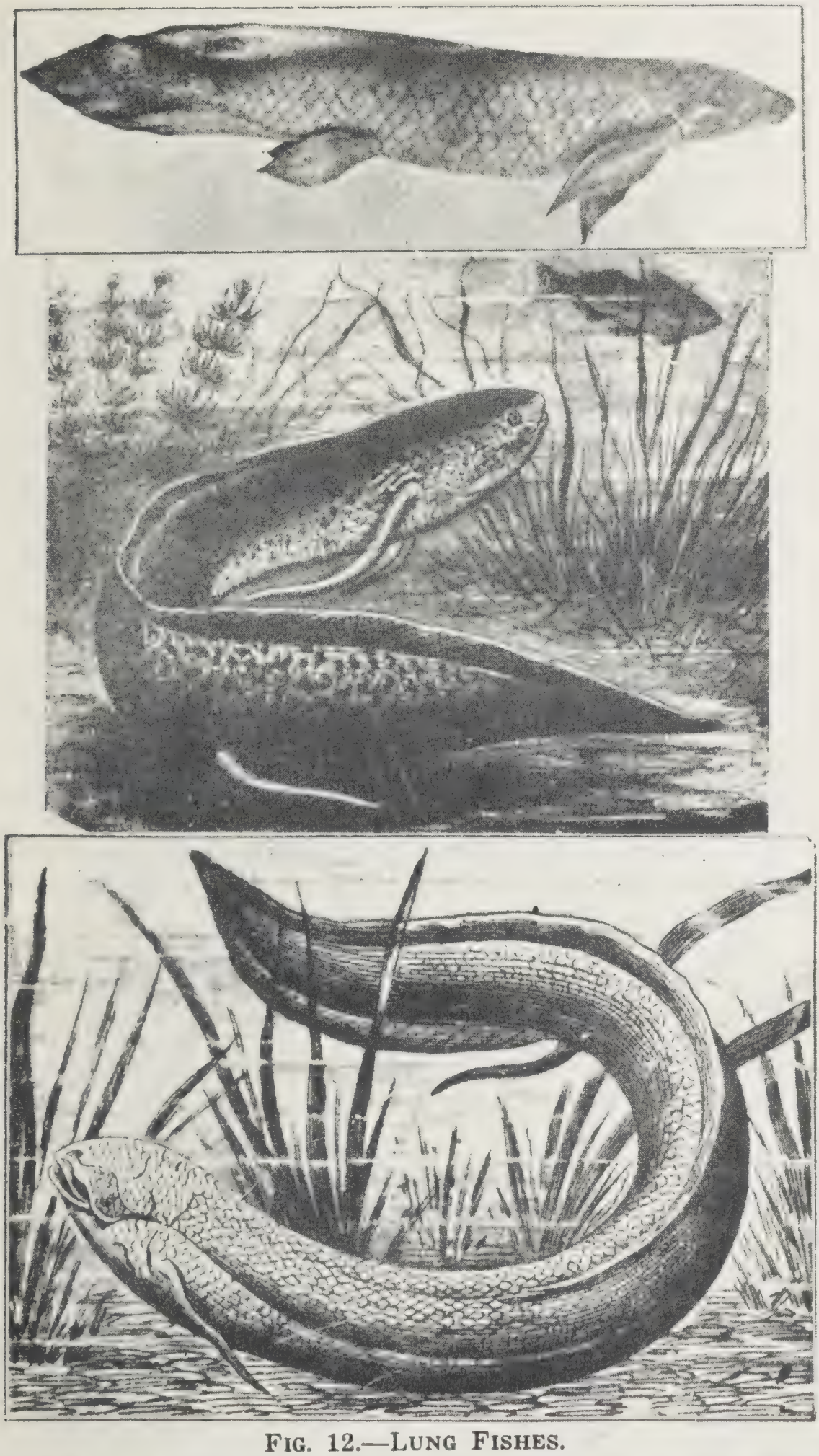

FIG. 12.—LUNG FISHES.

Australian Lung Fish, Ceratodus (top) : South African Lung Fish, Protopterus (middle) : South American Lung Fish, Lepidosiren (bottom).

of susceptible concave surfaces are destined to develop into the ears of land animals. Creatures with these primitive structures still exist among Nature's lowly forms.

From worms and worm-like creatures, were developed snails and a great variety of small animals, covered with shells. The Cambrian Rocks, the earliest rocks that have preserved fossils, have yielded the remains of some of these shell creatures (Fig. 8, upper). The Upper Silurian Rocks, belonging to a period much later than the Cambrian, have entombed the fossils of the molluscs shown in Fig. 8 (lower).

We must understand that by this time living things had been evolving for millions of years, yet these shelled animals were the highest forms that had so far appeared. We must understand, too, that only the skeletons of creatures possessing a bony frame could be preserved as fossils. The fleshy part of the body, Nature destroyed. Moreover, it must be realized that of the countless billions of creatures that have lived, the rocks have preserved the fossil remains of only a few. We must not expect too much from Nature's mutilated record. It is enough to know that the specimens that have been preserved prove the gradual unfoldment of life, and enable us to interpret the wonderful story of evolution.

There is a small animal known as the Amphioxus (Fig. 9). Standing midway between the

FIG. 13.—THE FLYING FISH.

worm and the fish, its distinguishing peculiarity lies in the fact that it has a rod of cartilage—the notochord—extending along its back, over which runs a line of nerve cells. This creature, the child of the worm and the parent of the fish, is of singular importance, since it foretells the coming of the vertebrates— the creatures with a backbone. In due time the fishes were evolved from the Amphioxus. The first fish appeared in the Devonian period, that is to say, when about one-third of the whole geological series of rocks had been formed. Fig. 10 (upper) represents a fossil of the earliest known fish. The skeleton shows a primitive form. The lower specimens represent other early fishes. Observe the curious worm-like resemblance of the middle one. There are still fishes of very unfinished form. Lampreys (Fig. 11) show, as it were, fishes in the making. They have strangely undeveloped heads, no jaws, and only a crude sucker-like cavity for a mouth.

The early fishes had no bones in their bodies. Their skeletons were composed of cartilage. Primitive fishes of to-day—sharks, rays, and others—have no bones. These fishes continue lines of descent from ancestors that appeared before the bony frame had been evolved.

Life was born in the sea; it moved from the sea to the land; and when this advance was made, it was the fishes that led the way. Some fishes developed lungs and began, tentatively at first,

to live on the shore or in marshes. Life was moving towards the amphibians, and the evidence of its advance in this direction has been preserved. As the Amphioxus is the link between the worm and the fish, so lung fishes are links between the true fishes and the amphibians. Fig. 12 (at the top) shows the Burnett salmon, of Queensland—a fish with one lung; below are two mud-fishes of Africa and Brazil—fishes with two lungs. These lung fishes, or double-breathers, have the

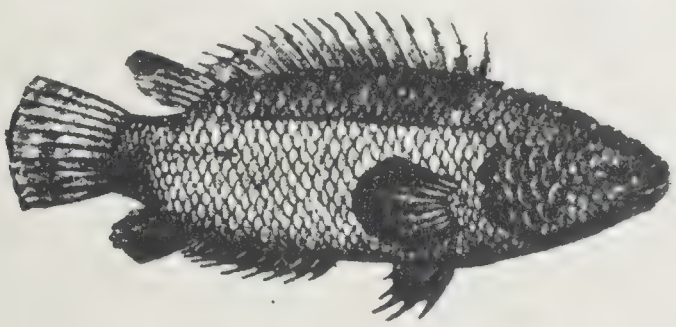

FIG. 14.—THE CLIMBING PERCH.

characteristics both of the fish and the frog. To scales and gills and fins and other features of the fish, they add lungs, nostrils, the beginning of a three-chambered heart, and other features of the frog. Living in regions from which the water periodically disappears, these creatures build around themselves in the dry season a shell of mud and leaves, and there, while awaiting the return of the water, they breathe air, and live on the fat stored up in their tails.

These lung fishes can walk on their fins; in fact, the fins of some of them are formed more like legs than fins.

The Flying Fish (Fig. 13) is another variation. This fish can sustain itself in the air for a hundred yards or more. Yet another curious fish that will not stay in the water is the Climbing Perch (Fig. 14). This fish may be seen crossing fields in India, and with the use of its fins it even climbs trees. These strange fishes are surely links to higher forms of life.

That the amphibian has been evolved from the fish may be seen in the evolution of the frog (Fig. 15). Number 1 shows the newly-hatched tadpoles; 2 and 2a show the branching, external gills; 3 to 8 illustrate further steps in the evolutionary process. The fish-like tail, so prominent in the early stages, is finally absorbed and we have the finished frog.

In the evolution of the frog we have a most suggestive illustration of the transformation of a creature during a single lifetime. The fish becomes an amphibian; the gilled, water-breathing creature become a lunged, air-breather; a water animal leaves its habitat for a home on land; a vegetable diet is abandoned for one of flesh. Truly, a striking summary instance of the power of evolution!

All that man has become, all the wealth and worth of the civilization he has achieved, has been due to the fact that he has possessed a hand which could obey the command of his brain. Without a hand, without fingers, man would still

FIG. 15.—THE EVOLUTION OF THE FROG.

be a wild beast of the forest. It was in the amphibian that Nature first produced the five divisions of the foot, which, inherited by the reptiles and then by the mammals, in the end became specialized into the human hand. The beginning of the hand is seen in the foot of the frog.

In the Carboniferous period, when the coal measures were laid down, appeared the wedge-headed amphibian, shown in Fig. 16 (above) and later, in the Permian period, the roof-headed amphibian (Fig. 16, below) was born into the world. This roof-headed amphibian is all the more interesting, for from some of these creatures were born the reptiles, from which, in turn, arose the mammals.

From the amphibians were developed the true reptiles, and these branched out into many forms. Some lived in the water, some roamed on the land, some flew in the air. In a warm climate, and where food abounded, some of these creatures, like the Ceratosaurus (Fig. 17), the Atlantosaurus and the Diplodocus, grew to a prodigious size. Some were fifty, some a hundred, some a hundred and fifty feet long; some had a hundred teeth, and eyes fifteen inches across; some weighed ninety tons, and made footprints a yard square. It was in the Mesozoic times, millions of ages ago, when these ungainly monsters were the monarchs of the earth. Happily, they have long since been extinct, and to-day their

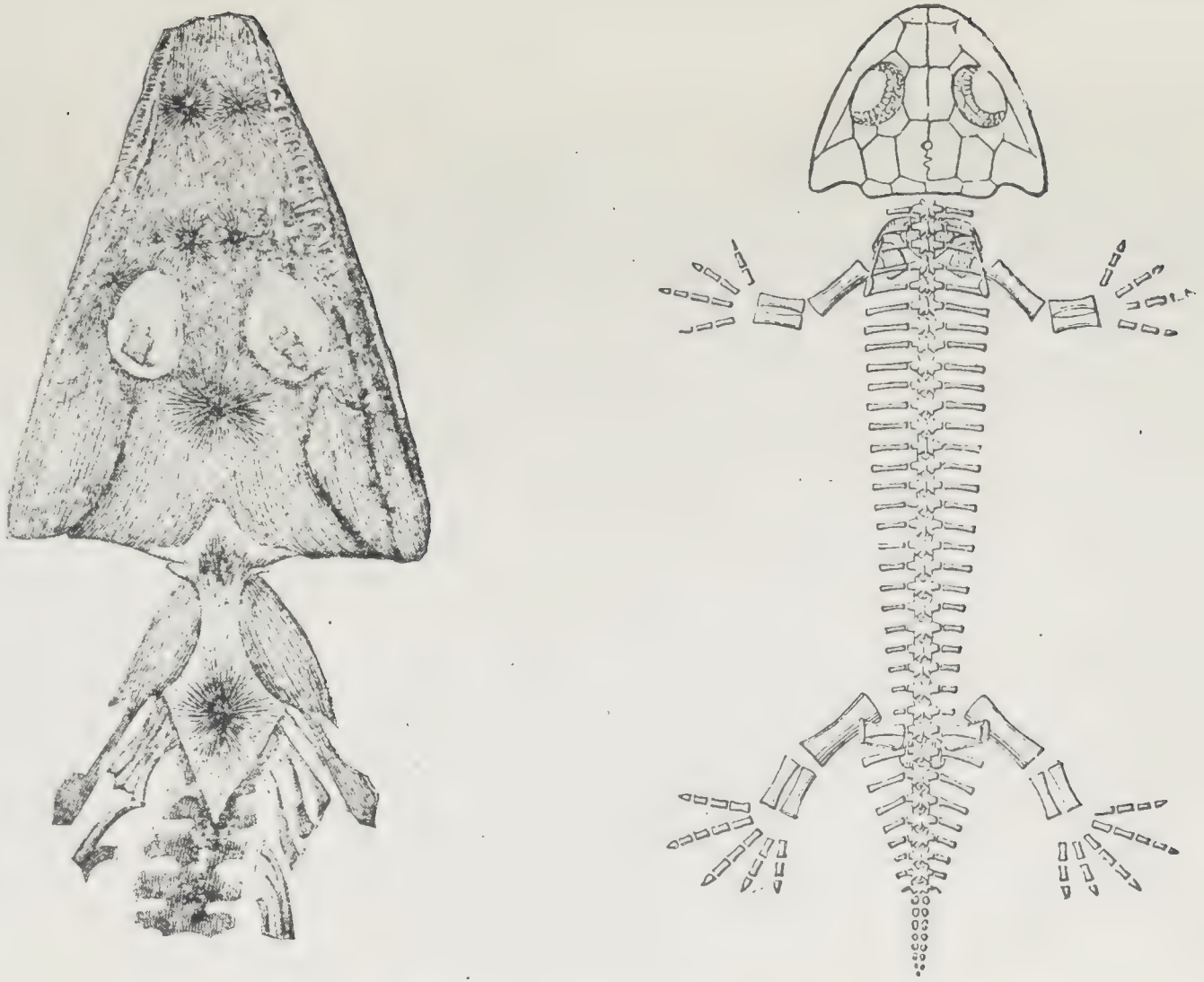

FIG. 16.—THE HEAD OF THE FAMOUS ARCHAEGOSAURUS.

The wedge-headed Amphibian (above); the Branchiosaurus—the roof-headed Amphibian (below).

colossal, though harmless, skeletons may be studied in the museums of the world.

From the reptiles came the birds. The first birds had teeth, claws on their wings, and bony tails of many joints (Fig. 18). The fossil remains of two of these reptile-birds—the earliest birds known— were found, some years ago, in the Jurassic limestone strata of Bavaria. These creatures had thirty-two teeth, three clawed fingers on each wing, and a lizard-like tail of twenty joints, with two long feathers growing out of each vertebra. Occupying the ground midway between the reptile and the bird, having the characteristics of both—the link between the four-legged animal and the feathered songster of the air—the Archaeopteryx, as this ancient bird is called, was about the size of a crow.

Another line of development led from the reptiles to the mammals—the hair-clothed creatures that suckle their young. This was the most promising line of Nature's advance, for at the end of this line, man was destined to appear.

An amazingly curious link, which connects the reptile with the bird on the one hand and with the mammal on the other, is the Duck-bill (Fig. 19). This creature, whose home is in Australia, is covered with dense fur and suckles its young, like a mammal; but, on the other hand, it lays eggs like the reptile and the bird. The eggs have large yolks, like those of birds; are hatched by

FIG. 17.—THE CERATOSAURUS.
A giant reptile of the Jurassic Period.

the warmth of the mother's body; and when the young is born, it lives on milk drawn from its mother's breast. Observe, too, that the mother Duck-bill has no nipples, but mere depressions in the breast, from which the milk oozes out among the fur, to be sucked up by the young. Think of a fur-covered, five-toed, web-footed, duck-billed, flesh-eating, swimming animal, housing itself in a burrow in the bank of a stream, being born from an egg, like a bird; formed in part like a reptile, and deriving its early sustenance by sucking the milk-ooze from its mother's teatless breast! This link between reptile, bird and mammal, this crude combination of three forms of life, shows finished forms in the making. It is the living proof of the manner in which Nature has accomplished her work—of the steps by which evolution has advanced. It is what Darwin called "a living fossil."

After the Duck-bills came the marsupial mammals—mammals whose young, born not yet fully developed, are carried for a time in a pouch attached to the body of the mother. The kangaroo (Fig. 20) belongs to this class. Here the advance is from an egg-laying mammal to one whose young is partly formed in the body of the mother. I say partly formed, for, although the kangaroo is as large as a man, its young, when born, though it is no larger than the little finger, is still a fœtus, so imperfectly formed that it

FIG. 18.—THE ARCHAEOPTERYX.
The lower picture shows the joints of the tail with the tail feathers.

must be carried for months in the mother's pouch, so that it may complete its development as a babe. Meanwhile, being unable to feed itself, the mother, by an exercise of her muscles, forces milk down its throat. Once more Nature, in her forward march, is blazing a new trail. Life, by employing crude makeshifts and adaptations, is fashioning for itself a higher mould.

The marsupial mammals were followed by the placental mammals, animals whose young are nourished before birth by a disc-like organ, called the placenta—the after-birth.

The Pariasaurus Baini (Fig. 21) shows Nature, the apprentice, trying to make a quadruped. I say trying, for see what a crude, raw specimen this monster was. The best thing that can be said of this fellow is that he had his day of fighting for a place in the sun and was then supplanted by higher creatures.

Many ages of progress, during which life assumed a rich variety of forms, including the early stages of most of the hoofed animals, brought the process of evolution to the lemurs, the monkey-like creatures that make their home in trees (Fig. 22). The lemurs differ from monkeys in that the milk glands of the female are on the abdomen instead of the breast, while the index finger of each hand, and the second toe of each foot, are furnished with claws, all the other fingers and toes having flat nails. Here again is

FIG. 19.—THE DUCK-BILL, KNOWN IN AUSTRALIA AS THE PLATYPUS.

a link between the lower and the higher life. Nature is stumbling and bungling, but getting there.

After the lemurs came the Slow Loris (Fig. 23). This species of the Loris has no tail, and its front foot bears a strong resemblance to the human hand. From these creatures, or possibly from similar creatures, were evolved the true apes (Fig. 24), and from these came the anthropoid or man-like apes.

There are still in existence four genera, or kinds, of these anthropoid apes—the gibbon, the gorilla, the orang, and the chimpanzee. The gibbon (Fig. 25) shows an alert, human-like expression, which is fully borne out in his pose. The picture of a female gorilla (Fig. 26) suggests with even greater force that we have here a human being in the making. Yet this creature, be it understood, may be separated from the lowest living human being by millions of years of development. The giant gorilla (Fig. 27), shot by Paschen, in the Cameroons, differed from the ordinary gorilla in the development of the skull and in size. He was six feet, eight inches tall from the crown of his head to his middle toe; the span of his arms was six feet, nine inches; his chest measurement was twice as great as that of a strong man. Yes, a dangerous gentleman to meet!

The approach to the human look on the face

FIG. 20.—A KANGAROO WITH HER YOUNG ONE IN HER POUCH.

The illustratior to the right shows a young Kangaroo shortly after birth. That the creature is a quite unfinished fœtus is obvious.

of the bald-headed chimpanzee (Fig. 28) is nothing less than remarkable. The form of the skull shows a decided advance towards the human. The countenance is, of course, a little open, but—well, the whole head so strongly resembles the human that he might almost be mistaken for one who believes the story of Jonah and the whale!

That man is related to the anthropoid apes becomes evident when his anatomical structure is compared with theirs (Fig. 29). While these creatures differ from one another as do the different races of men, as, for example, in the color of the skin, in the size and shape of the skull, and in the length of the arms and legs, they are all essentially man-like. And while all these creatures are like human beings in the formation of their skeletons, in their anatomical structure, and in their physiological functioning, each of them approaches more closely to man than any of the others in the development of some part of its body. Thus, "the orang approaches closest to man in the formation of the brain, the chimpanzee in the shape of the spine and in certain characteristics of the skull, the gorilla in the development of the feet and in size, and the gibbon in the formation of the throat and teeth." Prof. Ernst Haeckel, in the "Riddle of the Universe," sums up man's relation to the anthropoids as follows:

"Thus comparative anatomy proves to the

FIG. 21.—THE PARIASAURUS BAINI.

This skeleton was found in the Permian Strata of South Africa.

satisfaction of every unprejudiced and critical student the significant fact that the body of man and that of the anthropoid ape are not only peculiarly similar, but they are practically one and the same in every important respect. The same two hundred bones, in the same order and structure, make up our inner skeleton; the same three hundred muscles effect our movements; the same hair clothes our skin; the same groups of ganglionic cells build up the marvellous structure of our brain; the same four-chambered heart is the central pulsometer in our circulation; the same thirty-two teeth are set in the same order in our jaws; the same salivary, hepatic, and gastric glands compass our digestive process; the same reproductive organs insure the maintenance of our race."

Like human beings, these apes stand from three to six feet tall; like human beings, they weigh from one hundred to three hundred pounds; like human beings, they have only a rudimentary tail of from three to five joints imbedded at the extremity of the spine; like human beings, they stand on their hind legs and grasp things with their hands; like human beings, they live in families; like human beings, they are brave, quarrelsome, impulsive, emotional, and capable of a limited exercise of reason.

In their native forests, apes laugh, sing, dance, and converse with one another. Their language

FIG. 22.—THE RING-TAILED LEMUR OF MADAGASCAR.

is a series of sounds with definite meanings.

Yet it is not held that man has descended from any of these existing anthropoid apes. What is held is that these creatures and human beings represent two different lines of development from the same ancestors.

But what of the "missing link" between the early ape-like creatures and primitive man? In 1891, Dr. Eugene Dubois, a Dutch military physician, found near Trinil, in Java, some interesting bones and some teeth. The International Zoological Congress, held at Leyden in 1894, voted that these bones had belonged to a form intermediary between ape-like creatures and men. The creature was named the Pithecanthropus Erectus—the erect ape man.

Fig. 30 (upper) shows a restoration of the skull of this ape-like human being, placed, to facilitate comparison, above the skull of a modern man. The formation of the skull of this creature represents a decided advance over any existing anthropoid ape; but the prominent supra-orbital ridges, the low, retreating forehead, and the massive, prognathous jaws, which gave a brutish angle to the face, are distinctly ape-like characteristics.

The most interesting feature of this primitive creature's approach to man was the volume of his brain. The quantity of the brain of the highest ape measures about 600 cubic centimetre

FIG. 23.—THE SLOW LORIS—ANOTHER TYPE OF LEMUR.

There are fifty known species of the lemur, of which thirty-six belong to Madagascar. The others are found in Africa and South-Eastern Asia. They were formerly much more widely distributed, and many fossil lemurs have been found in North America.

units. In some Australian "black fellows" the brain capacity runs as low as 900 units, while in others it reaches 1500. The brains of civilized men vary in bulk from 1000 to 2000 units, which gives 1500 cubic centimetres as the brain capacity of the average man. Now the skull of the Pithecanthropus Erectus shows that his brain measured nearly a 1000 cubic centimetres. In other words, the brain capacity of this primitive ape-man was about equal to that of some of the exceptionally low existing savages, and somewhat less than midway between that of the highest anthropoid ape and the average civilized man. This man lived some 500,000 years ago.

Men of science believe that the first human beings arose in Southern Asia, if not, indeed, in a region still more southerly than the present Asiatic boundary—in Lemuria, the former land extension now submerged beneath the Indian Ocean. The evidence of fossils supports this view. And it is significant that the bones of the ape-man of Java were found on the very edge of the Indian Ocean.

From Asia, the rude forefathers of our race migrated over the earth. Asia was then united to Africa, and joined hands with Europe at the Dardanelles and Sicily, and with North America at Behring Strait. Other land connections joined Africa to Europe at Gibraltar and flung a broad thoroughfare from the Dark Continent to Aus-

FIG. 24.—THE BABOON.

There are numerous species of the Baboon as of the other "true apes"—a name applied to them as animals that run on all fours. The Baboons are now confined to Africa and Arabia, though they formerly inhabited India. They have short tails, short, strong limbs, hands and feet remarkably like human hands and feet, and well-developed brains. They go in troops, following the lead of a patriarch and guarded by a sentinel. They attack other animals and make raids on property. "They are sometimes caught by being intoxicated with liquor purposely exposed near their haunts, fondness for stimulants being one of their often observed vices."—"Chamber's Encyclopaedia." "The Anubis Baboons, as shown by the frescoes, were tamed by the ancient Egyptians and trained to pluck sycamore figs from the trees."—The Encyclopaedia Britannica."

tralia. Over these land routes and others some of our naked ancestors in humanity's early dawn wandered from the cradle of the race in Asia and took up their habitations in the different continents and in the islands of the seas.

Since 1848, numerous fossil remains of man have been found, first, at Gibraltar, and later in Germany, Belgium, France, England, the Caucasus, Africa, and North and South America. These bones, which range from fragments of skulls, jaws and teeth to entire skeletons, represent various stages of human development from ape-like creatures to modern man. The possessors of some of these bones were "missing links" in our ancestry.

In 1911, a remarkable skull, which is believed to be approximately 400,000 years old, was found at Piltdown, in Sussex, England. This skull is essentially human in its smooth forehead, the absence of bulging ridges over the eyes, and in the development of the bones of the brain case. The brain it held was about equal in size to that of the savages of Australia. Yet it is remarkably flat and very thick, like that of an anthropoid ape. The teeth are longer than in modern man and bulging, and the prominent canines are distinctly ape-like, while the chin retreats in heavy jaws. Uniting as he did such decidedly human and ape-like characters, the owner of this skull, the Pilt-

FIG. 25.—THE WHITE-HANDED GIBBON

The Gibbon, of which there are many species, is found in Assam, the Malay Peninsula, Java, Sumatra and Borneo. The animal is remarkable for its agility and for the wierd cries with which it makes the woods resound at night. The above illustration and the following illustrations of anthropoid apes are reproduced from Professor Ernst Haeckel's great work "The Evoution of Man," with the permission of the publishers, Watts & Co., London.

down man, has been described as "man in the making" and called the "dawn man."

In the Maure sands, near Heidelberg, in 1907, there was found, in a perfect state of preservation, a complete jaw with the teeth. the relic belonged to a member of the Heidelberg race—a very low type of human being. Speaking of this discovery in his "Men of the Old Stone Age," Professor Henry Fairfield Osborn, after describing it as "one of the most important in the whole history of anthropology," says it is "unquestionably human from the nature of the teeth," and adds that it "ranks not far from the point of separation between man and the anthropoid apes." Professor Osborn estimates the age of this human relic at about 250,000 years.

The Heidelberg race was followed by the Neanderthal race, which entered Europe probably from Africa. All the physical features of Neanderthal man (Fig 31), unite in constituting him a "distinct species of man." Though he bore in his body the obvious marks of his simian origin—heavy, overhanging eyebrows, a markedly retreating forehead, large jaws and a diminutive chin—he nevertheless possessed a signal advantage over every earlier race of creatures. He had a large head, and in the cavern of his skull he carried the largest and best brain that had so far appeared in Europe. In stature, the Neanderthal man was short, broad shouldered, stocky; his

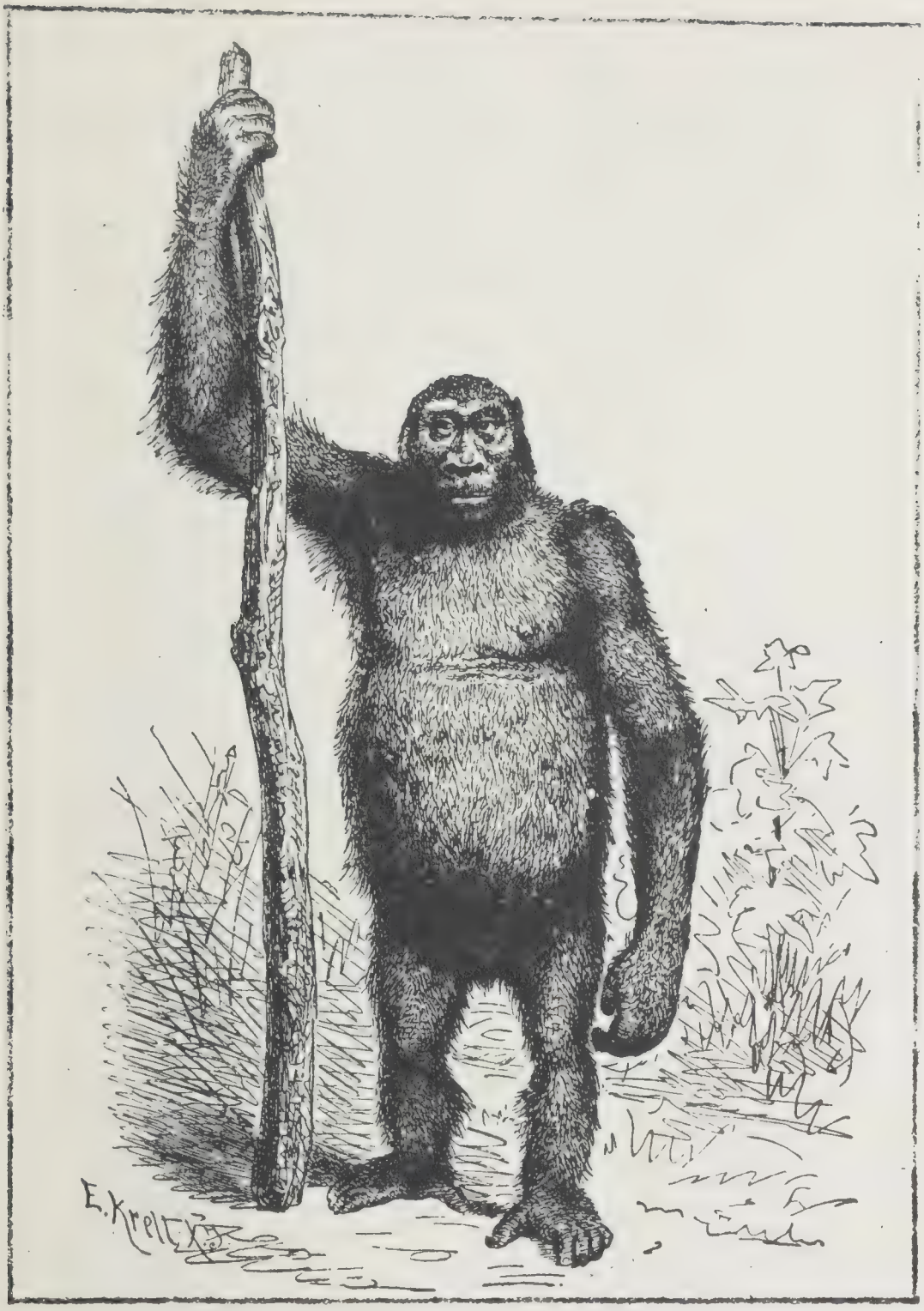

FIG. 26.—A FEMALE GORILLA.

The gorilla is the largest of the manlike apes. It is distinguished from the other anthropoids by its small thumb, small ears, elongated head, a deep groove alongside the nostrils and other features. The gorilla is a black animal whose home is in West Equatorial Africa. The outstanding great toe of the gorilla and the other anthropoid apes is found, though in a less pronounced condition, among savage tribes of Asia. See the photograph of "One of the 'Monkey Men'" in an article on the Malekula tribes in "Asia, The American Magazine On The Orient," for June, 1921. Of this savage, Mr. Martin Johnson, the Asiatic explorer, says: "He could grasp a branch with his great flat feet as easily as I could with my hands."

arms and legs were muscular and powerful and his hands large.

The Neanderthal people spread over Croatia, Austria, Hungary, Germany, Switzerland, Belgium, France and England; and in the soil of all those countries, buried now in some places to a depth of forty feet below the actual surface, they left millions of imperishable memorials of their handiwork—weapons and tools made from chipped flint and other kinds of stone—sharp weapons for throwing and cutting, and tools for dressing skins and shaving wood.

Contemporary with this early race in the wilds of Europe, were the hippopotamus and rhinoceros, the cave bear and hyena, the woolly mammoth, the giant deer, the bison, the sabre-toothed tiger and other long since extinct creatures. These the Neanderthals hunted, eating their flesh, splitting the larger bones for the marrow, opening the skulls for the brains, making anvils of the large, flat bones, and in the cold winters clothing themselves with the skins. This and more is evidenced to-day by the numerous bones of these animals which are found associated with the tools which Neanderthal man used at least 200,000 years ago.

Turning their attention to art, these people made drawings on bones and stones of various animals and human beings. The human forms are always represented in the nude, and it is note-

FIG. 27.—MALE GIANT GORILLA.

Killed by H. Paschen, at Yaunde, in the interior of the Cameroons, and stuffed by Umlauff.

worthy that they invariably show signs of being covered with hair.

The Neanderthal race had its day and disappeared from Europe. Perhaps it was greatly reduced by the rigors of the fourth glacial period. Perhaps its remaining numbers were decimated in wars with a superior people; for that superior people was at hand.

Some 25,000 years ago, a new race—the Cro-Magnon people—invaded Europe. These people were from Asia. They belonged to a stock totally different from the Neanderthals from whom they wrested a continent. Tall in physique, with high, straight foreheads, and large, well formed brains, they were a hardy race of hunters and the most intelligent and progressive race the world then knew. Their superior industry in the working of flint everywhere superseded the Neanderthal. They had imagination, ideals, and knew the customs of civilized life. They were artists with a high sense of beauty and proportion. Their carvings on bone implements, their sculptures, and the realistic paintings on the walls of their caves represent an art whose delicate finish and superb proportion remained unrivalled in its field until the reign of the Greeks. They decorated their dead with strings of perforated shells, and with them buried flint weapons and offerings of food. Writing of these people with evident enthusiasm, Professor John M. Tyler, in

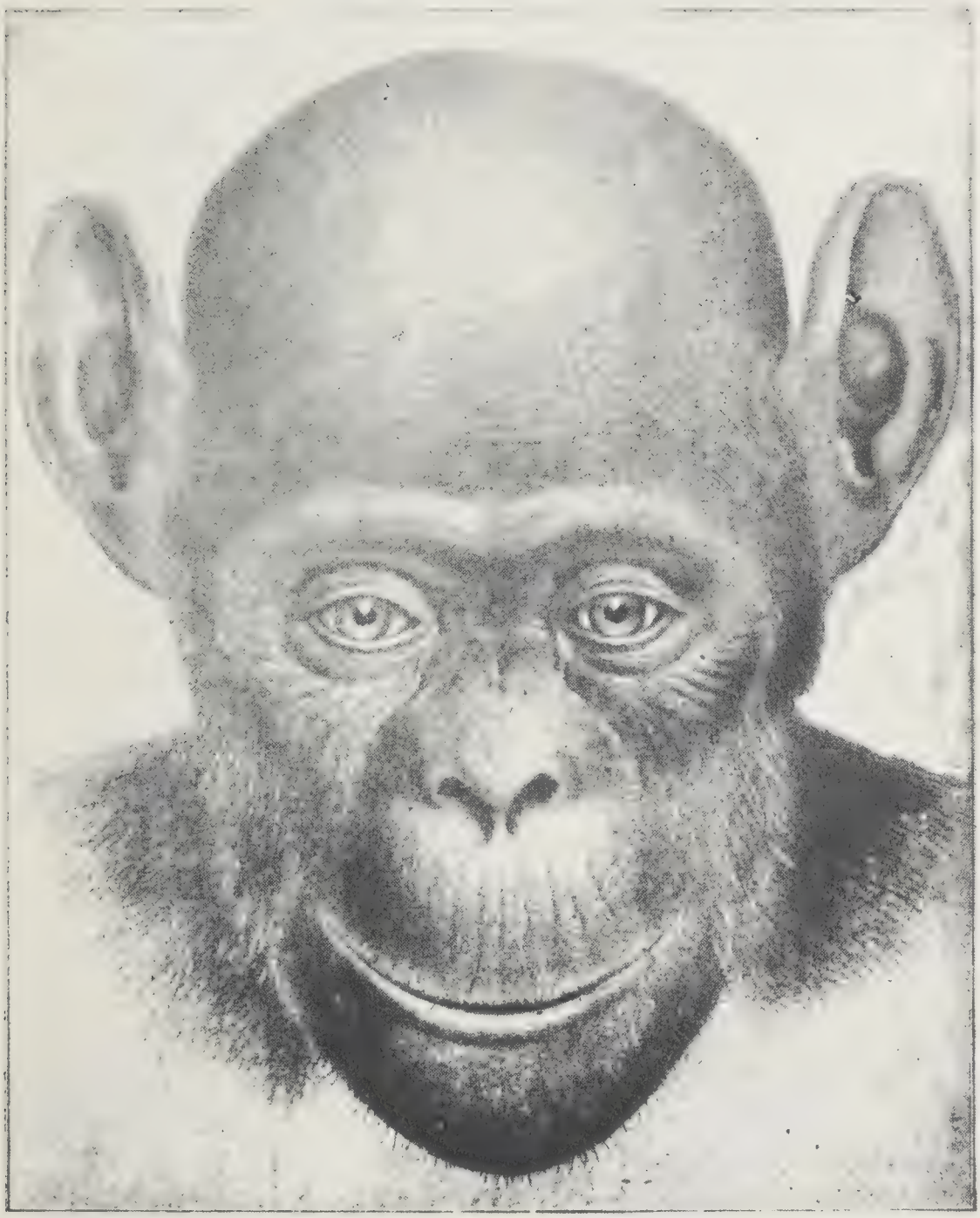

FIG. 28.—THE BALDHEADED CHIMPANZEE.

The Chimpanzee is a native of West and Central Equatorial Africa. "There are various races or varieties of Chimpanzee, and all of them show a degree of black pigmentation. In one variety the skin becomes totally black; in another, pigmentation of the face and of other parts, is delayed until late in life; in others the face never becomes absolutely black."—"Man, a History of the Human Body," by Dr. Arthur Keith.

"The New Stone Age in Northern Europe," observes: "The Cro-Magnon people have excited the wonder and admiration of all anthropologists."

In the Cro-Magnons evolution had at last produced a race of real men—men with well moulded heads, with large, competent brains, with a straight facial angle, with well formed jaws and teeth and chin, with manly eyes looking out beneath an intellectual brow and lighting up a face whose whole contour was rugged but thoroughly human.

Other races came upon the scene, and there was a mingling of races and a clashing of cultures; but the Cro-Magnons, though they declined in numbers, persisted, and became, as is believed, one of the lineal ancestral races of modern man.

The geographical centre of the European distribution of the Cro-Magnon people was at Dordogne, in southwestern France, and in the present inhabitants of Drodogne, of Brittany, and of other districts in France are found essentially the same skull formation, features and complexion as were characteristic of this remarkable type of prehistoric man. Of this unique racial continuity. Prof. Ripley, in his learned work on "The Races of Europe," says: "It is, perhaps, the most striking instance known of a persistency of population unchanged through thousands of years."

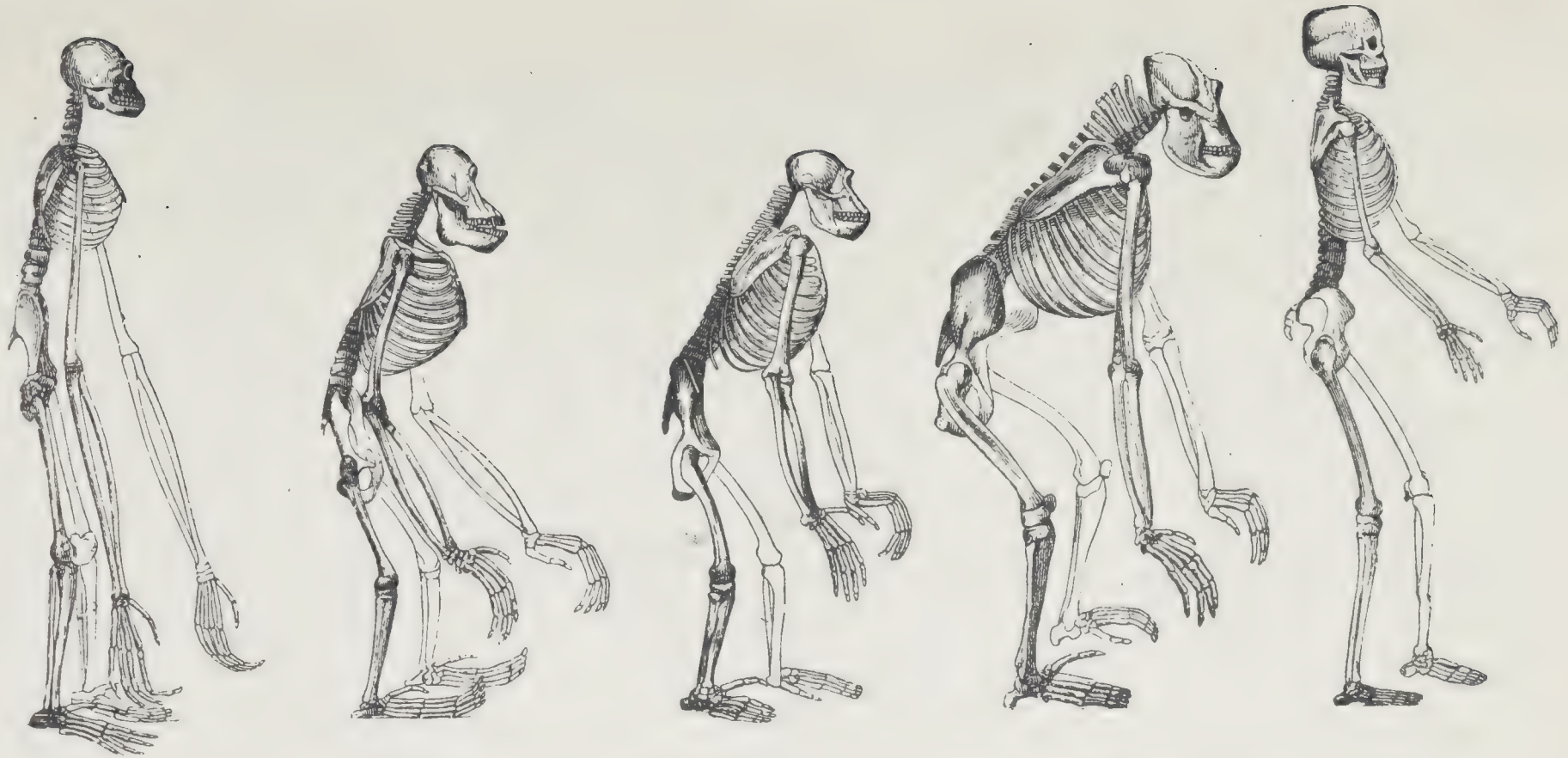

FIG. 29.—THE SKELETON OF MAN AND OF THE FOUR ANTHROPOID APES.

From Haeckel's "Evolution of Man." From left to right the order of the skeletons is as follows: Gibbon, Orang, Chimpanzee, Gorilla, Man.

The evolution of animal life was paralleled by the rise of an equal diversity of forms in the vegetable world. From the Monera—organisms so lowly that it cannot be determined whether they are plant or animal—life diverged in opposite directions, producing, on the one hand, the plant, on the other, the animal. Organisms that could feed on inorganic matter assumed a stationary character and became the ancestors of the plants. Creatures that required organic food developed powers of locomotion to facilitate the search for sustenance, and of these were born the varied forms of earth's animal population. From the first microscopic plants, vegetable life proceeded to seaweed, to mosses, to ferns, to the pine and the yew, to the vines, the fruit-bearing and flowering plants that crowd the forests and beautify the gardens of the world.

The truth of this wonderful story of evolution, of the progressive improvement of living forms with the advance of time, is proved by several lines of evidence. One of these lines of evidence is found in the fossil remains of the life of earlier times. Fossils are relics of forms that lived in the long ago. Dying, they were buried in sediment by the hand of time, and to-day they are found in rock formations, where they have been preserved from the destructive power of the ages. Now, if living things have developed in an increasing variety of forms as time has gone on, and if

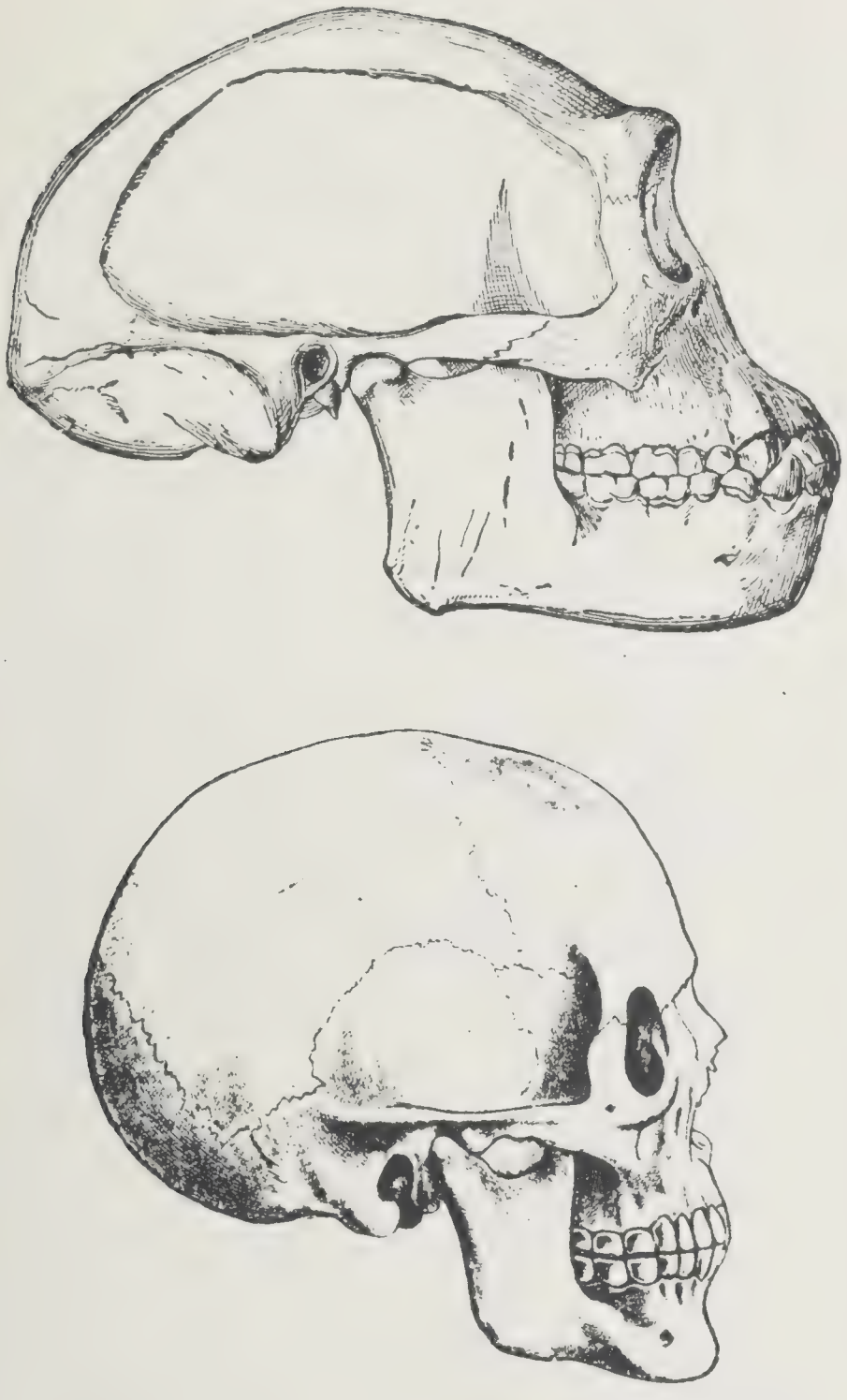

FIG. 30.—SKULL OF THE FOSSIL APE-MAN OF JAVA.
(Pithecanthropus Erectus.)
Restored by Dr. Eugene Dubois, and the skull of a modern European.

the stratified rocks of the earth's crust, as they have grown from age to age, have kept a record of these living things, these testimonies of the rocks must prove the gradual unfoldment of the world's life. Such precisely is the case. The earlier rocks are poor in fossils, because in the earlier ages the world was poor in life; but in the succeeding rocks, there is a larger deposit of fossils; and the rocks of every progressively later age show an ever increasing wealth of fossil remains.

The earlier rocks contain fossils of the lower forms of life, like seaweed and simple creatures in shells; in succeeding rocks come the fishes—the first living things with a backbone—primitive forms being followed by more elaborate types; in later strata are found the fossil remains of the amphibians; following these, in rocks higher up, are the relics of the reptiles; then come the reptile-birds, and in still later rocks appear the primitive mammals; onward and upward rises the spiral of life, and in yet later rocks occur placental mammals—early horses, marmosets and lemurs; higher still, the strata imprison fossil cats, pigs, elephants, antelopes and apes; and over the fossil remains of all other creatures, in the rock-crust of the earth, as is required by the facts of biological unfoldment, lie the fossilized forms of man-like apes and men. Thus geology confirms the conclusions of biology.

FIG. 31.—A RESTORATION OF THE NEANDERTHAL MAN.

This picture is a retouched photograph taken of a model made by Guernsey Mitchell according to instructions of Prof. Henry A. Ward of Chicago. Reprinted with the permission of The Open Court Publishing Co.

In Fig. 32 we have a series of fossil heads from different periods in the ascending geological order, illustrating the gradual development of the elephant's tusks and trunk. See how the tusk, beginning as an upper tooth in the Eocene period when the elephant was no larger than a rabbit, gradually lengthens as the periods pass, until we get, after millions of years, the great curved tusk of the elephant of to-day. The growth of the trunk kept pace, of course, with the extension of the tusks. On the left side may be seen the gradual and corresponding modification of the elephant's teeth.

The horse, the noblest of the quadrupeds, has been evolved from a small five-toed animal. The Eohippus, the "dawn horse," whose fossil remains have been found in the lower Eocene rocks, was no bigger than a small fox (Fig. 33). It had four toes and a splint on each front foot, and three toes and two splints on each hind foot —which proves that its ancestors had five toes on each foot. The "dawn horse" was a browsing animal. Restorations of this little horse, and of the larger three-toed horse that followed him, are now familiar figures in natural history museums. Evolution, you see, is not a figment of somebody's imagination; it is, rather, the compelling, common sense interpretation of the facts of nature.

All modern horned animals have been evolved from ancestors that were without horns. The pro-

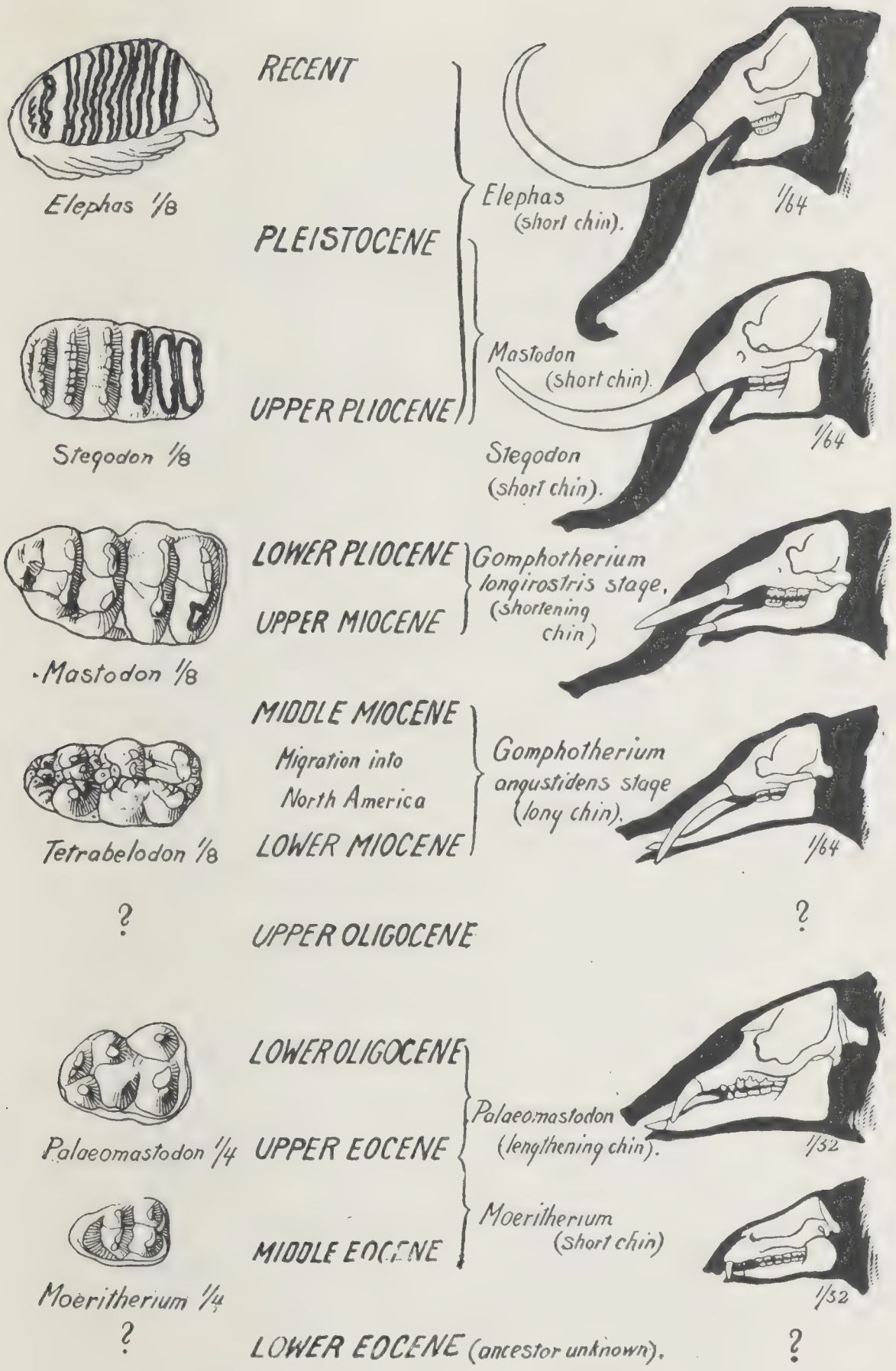

FIG. 32.—EVOLUTION OF THE PROBOSCIDEA.

On the right, a series of skulls; on the left, last lower molar. Reprinted with the permission of the author and publishers from Prof. William B. Scott's "A History of Land Mammals in the Western Hemisphere." The Macmillan Co., New York.

genitors of the deer, the elk, the caribou, the moose, before the Miocene period, were entirely destitute of horns. Then the first horns appeared, each as a simple prong. As the succeeding ages passed away, the horns gradually increased in size and took on more prongs. The fossil antlers, found in the successive rock formations from the Miocene period onward, show the gradual evolution of the horns that adorn the heads of living animals (Fig. 34).

But this is only half the story. The history of an individual creature is called ontogeny. The history of a race of ceatures is called phylogeny. Now, it is a biological law that ontogeny is always a recapitulation of phylogeny; that is to say, that every creature in the course of its development, especially before birth, passes through the various stages permanently occupied by its ancestors. We see this law beautifully illustrated in the growth of the antlers of one living deer (Fig. 35). During the first year, or thereabout, the deer develops one plain horn, and each year thereafter another prong is added, until after a series of years, the antlers are full grown and full-pronged. In other words, each and every deer, in the development of his horns, repeats the long experience of his race in acquiring horns.

Now, this process of recapitulation applies to man as well as to all other creatures. This brings us to another line of evidence which proves the

FIG. 33.—EOHIPPUS, THE "DAWN HORSE," FROM THE LOWER EOCENE ROCKS.

Restored from a skeleton in the American Museum of Natural History, New York. Reprinted with the permission of the author and publishers from Prof. William B. Scott's "A History of Land Mammals in the Western Hemisphere." The Macmillan Co., New York.

truth of evolution—embryology, or development before birth. Dogs, cattle, sheep, elephants, horses, apes, men and all other mammals had the same origin. Therefore, the early stages in the evolutionary process were the same for all these creatures. That is to say, the course of life's development, before diverging toward these respective forms, followed for a time a general line of advance..

The truth of this is strikingly illustrated in Fig. 36. Here we have the embryos of four mammals in different stages of development—the dog, the bat, the rabbit and man. These embryos prove that all these creatures have come through the same line of development; that they all had the same remote ancestors. The distant ancestors of all these creatures were fishes in the sea, and here, in the embryo of the dog, the bat, the rabbit and man, we have, still persisting, the gill-clefts of the fish (top row). These gill-slits, which all mammals, before birth, still inherit from the fishes through which ascending life passed in the morning of the world, occasionally persist in man throughout the embryonic period and appear in the child's neck as fissures pointing towards the throat, through which milk, when swallowed, passes to the outside of the neck. Only on the theory that all mammalian life, including man, has evolved through the fish stage does the persistence of these gill-clefts become intelligible.

The embryonic development of man and the other mammals demonstrates their remote relationship and their gradual evolution. The dog, the sheep, the ox, the horse, the ape and man and every other mammal begins life as a single cell. That cell grows and divides into two; the two enlarge and divide into four; the four divide into eight. Dividing in this way, the cells come to form a cluster resembling a mulberry. This is the morula stage. The cells now form a hollow sphere, one cell in thickness, and the sphere fills with fluid—the blastula. Now the sphere, like a punctured India rubber ball, falls in upon itself, assuming a cup shape with double walls. This is the gastrula stage, when the embryo resembles a worm in the figure of a horseshoe. A third layer of cells is now formed between the other two, and from these three layers of cells are gradually unfolded all the complex parts of the body. From the outer cells arise the skin, the hair, the lenses of the eyes, the nervous system, the membranes of the mouth and nose, and the enamel of the teeth; from the inner cells arise the lining of the larynx, the trachea and the lungs, the intestines, the liver and the thyroid glands; from the middle layer of cells are formed the skeleton, the inner structure of the teeth, the muscles, the blood-vessels and the blood itself, the membranes of the heart and lungs, the kidneys and the reproductive organs.

For a time the human embryo is a simple

FIG. 35.—ANTLERS OF ONE DEER AT DIFFERENT STAGES OF THEIR DEVELOPMENT.

trunk, without skull or spine, without arms or legs, with only a pulsating tube for a heart. Then the rod of the amphioxus appears running down the back; then the growing embryo resembles a fish, with gill-slits in its neck and with a two-chambered fish heart; then comes the reptile stage when the babe has a three-chambered heart and other features of his reptilian ancestors; then the heart becomes four-chambered and the babe, passing through other transformations, reaches the finished human form.

In all these details of growth, the development of man is paralleled by the development of every other mammal. And certainly only one conclusion may be drawn from the fact that for a time in the embryonic life of the rabbit, the sheep, the pig, the dog, the ape and man, these creatures are formed and look so nearly alike that even the man of science, unaware of their identity, cannot distinguish one from the other.

The significant structural similarity of nearly all living creatures points unmistakably to evolution. For example, the limbs of amphibians, reptiles, birds and mammals consists of one long bone above, then two shorter bones below, then two transverse rows of bones forming the ankle, with the foot ending in five toes. In the foot of the crocodile, in the flipper of the seal, in the paddle of the whale and in the foot of the dog may be seen the general plan of the human hand. So

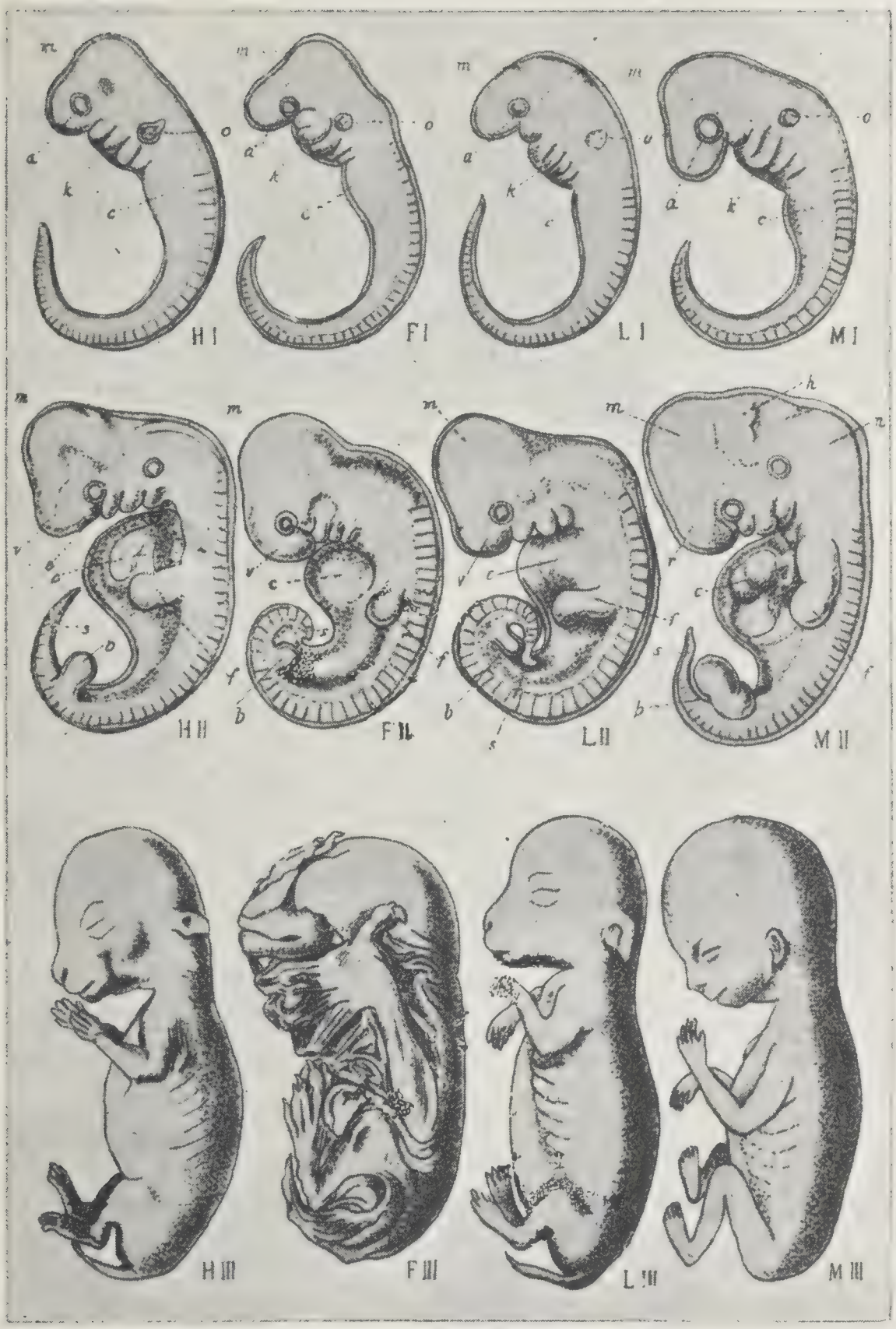

FIG. 36.—EMBRYOS OF FOUR MAMMALS.
Dog, Bat, Rabbit, Man—at Three Different Stages of Development.

the wing of the bat or bird, the forelimb of the lizard or elephant and the little shovel-like leg and foot of the mole present the same number of bones in essentially the same structural arrangement as do the arm and hand of man. It is the different uses to which these organs have been put that have determined their various developments.

Comparative anatomy traces the arms and legs of man through various land forms back to the limbs of fishes. And the human heart and lungs, the liver, kidneys and stomach, the eyes and ears, the nose and mouth, have been fashioned from the organs of primitive creatures through successive modifications during countless ages. The larynx, which makes possible the human voice, appears in diverse stages of development in the Amphibia.

Man's remote ape-like progenitors had tails, and for a time in its embryonic development, the human babe has a tail longer than his legs (Fig. 36, middle row). Moreover, in the annals of medical science, there are records of many otherwise well-formed children born with tails. Professor Haeckel, in his "Evolution of Man," shows photographs of a six-months-old tailed boy (Fig. 37). The presence of this tail is another rare instance of the vaulting power of heredity—a case in which Nature recalls a phase of her distant life.

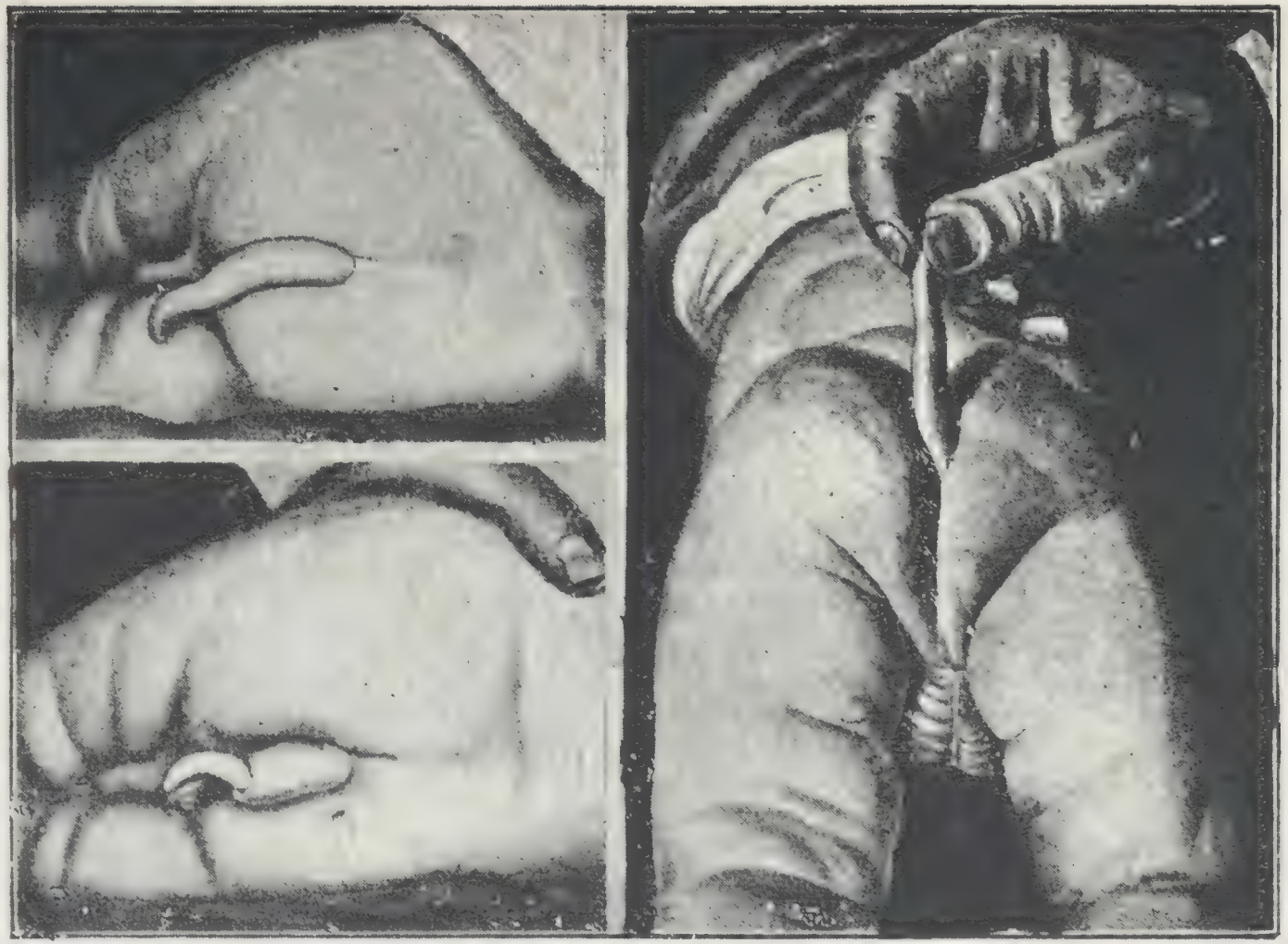

FIG. 37.—TAIL OF A SIX-MONTHS-OLD BOY.

Removed by Operation by Dr. Granville Harrison, in 1901. "A great number of such cases," says Haeckel, "are given by Max Bartells in his essay on 'Tailed Men,' 1884."

Every human being carries the rudiment of an ancestral tail, the coccyx, at the base of his spine. In the human embryo, the very muscles for wagging this tail are still found. In adult man these muscles are represented, as a rule, by bands of fibrous tissue. Occasionally, however, the dissecting surgeon finds these muscles well developed in the body of a man or woman. Science says that evolution alone can explain this lingering relic of a tail, with its attendant muscles, in the human body.

This brings us to another line of evidence, which proves the truth of evolution—the presence of rudimentary organs. Fig. 38 shows the vermiform appendix in the orang, in man, and in the babe before birth. It is much larger in the ape than in man. Man has inherited it from his ape-like ancestors, and while it serves no purpose in his body, its infection is the source of the frequently fatal disease, appendicitis.

Then there are the rudimentary muscles of the ear (Fig. 39). In our remote progenitors these muscles were developed, and with them they could move their ears. Monkeys move their ears, though not with the facility characteristic of horses and dogs. Occasionally a man is found who can move his ears as we move the skin of the forehead. But in the anthropoid apes and in most men these muscles are inoperative. Through disuse they have become rudimentary. When the

ancestors of these apes and men began to assume the erect posture, they also began to turn their heads, instead of their ears, in the direction of sound. As the erect posture was improved, the turning head answered with increasing loyalty the call of the sound waves, and after innumer-

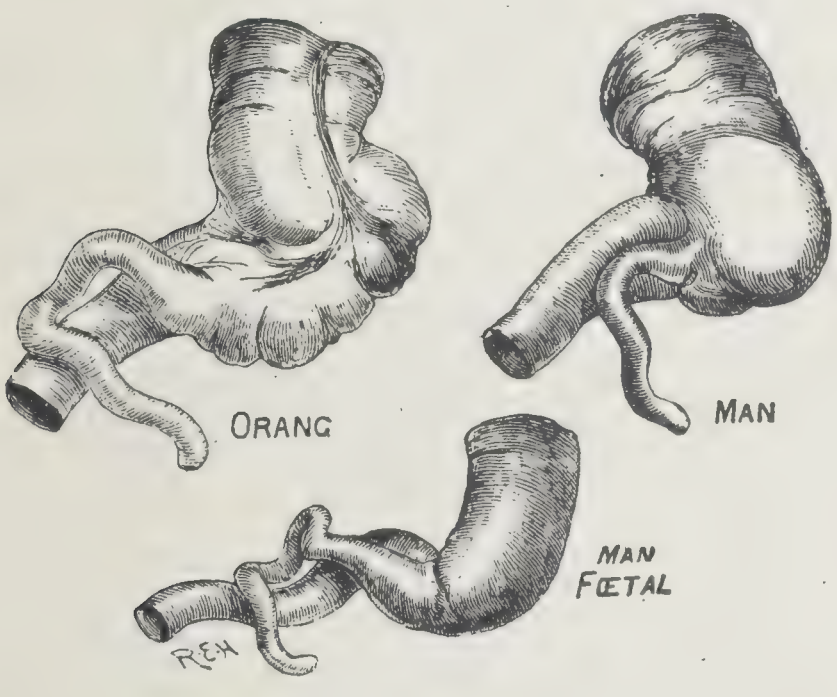

FIG. 38.—THE VERMIFORM APPENDIX IN THE ORANG, IN MAN, AND IN THE HUMAN FOETUS.

able ages of comparative rest and disuse, the ear muscles dwindled into their present impotence. Here, again, evolution alone explains the facts.

Moreover, the whole external ear is a rudimentary organ—a structure that has outlived its function. The male breasts point to a time when the father as well as the mother suckled the

young. In some men the breasts are as well developed as in women and supplied with milk, and in many known instances babes have been suckled at these male breasts. Again, in some women and occasionally in men, two or more pairs of breasts appear—a fact which plainly shows that man has descended through humbler forms of life. Still another rudimentary organ is the nictitating membrane—the little fleshy pad at the inner corner of the eye—the relic of a third eyelid that our ancestors in the dim past flashed across the eyeball as the turtle and the eagle do to-day.

Man has evolved from creatures that went on all fours and lived in trees, and in consequence of his upright posture and changed habits of life, some structures which are active in the apes are rudimentary in the human body. A shoulder muscle that is a source of strength to the apes in climbing, lingers in man as a mere fibrous remnant that has dwindled through disuse. Another muscle which runs through the wrist into the palm of the hand, another which extends from the calf of the leg to the sole of the foot, another which passes from the shoulder to the neck and was once used to lift the collar bone—these muscles, which are well developed in the true apes, and less developed in the anthropoids, are rudimentary in man. These rudimentary organs and muscles are links in the chain of man's de-

scent and they point unerringly to the source of his origin.

The long heel and the poorly developed calf of the anthropoid ape remind us that he has but recently, so to speak, acquired the upright posture. In the negroid races also the long heel and diminutive calf are notable characteristics; while in the white and yellow races the heel is short and the

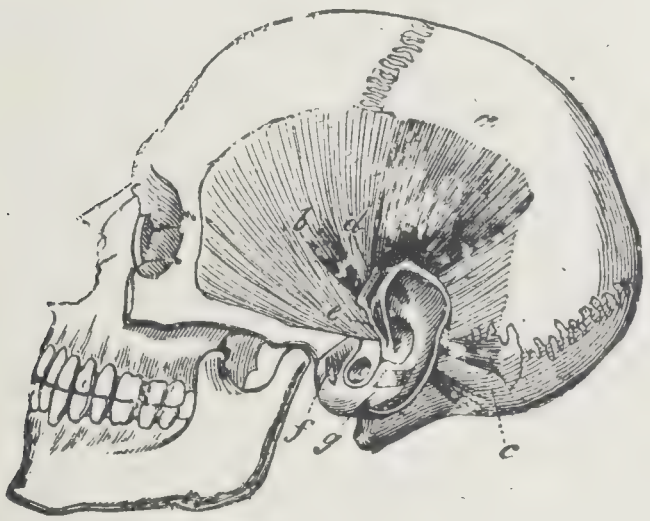

FIG. 39.—THE RUDIMENTARY MUSCLES OF THE EAR.

calf well formed and muscular. Once more, the obvious conclusion is that the black man's long heel and slender calf represent a more primitive development; while the leg and heel of the white man and the Mongolian show the work of evolution farther advanced.

Three months before birth, the human babe is covered with a luxuriant growth of soft, brown hair, called the "lanugo," precisely the same as

the ape baby. And throughout life the body of every human being is covered with a rudimentary growth of hair. But this it not all. It is as suggestive as it is interesting that in man and in the anthropoid apes the hair on the upper arm and the hair on the lower arm always grows towards the elbow (Fig. 40)—a phenomenon which occurs nowhere else in the animal world except in a few American monkeys. In a primitive Australian race, the Ainos of Japan, and the pygmies of the Upper Nile, the extreme hairiness of the body is a notable characteristic. And the photograph of Julia Pastrana, a Siamese (Fig. 41), shows that this lady was not only bearded like a man, but that her entire body was plentifully clothed with hair. Some chimpanzees, on the other hand, are remarkably hairless. One variety is, in fact, almost entirely bald.

If any organ in the human body could distinguish man as a creature standing apart, and argue that he has not been evolved from ape-like ancestors, that organ should be the brain. But the brain yields surprising evidence of man's kinship with these creatures. Fig. 42 is introduced to show the remarkable similarity in the brains of the anthropoid apes and men. The lower four are the brains of apes; the upper one to the right is the brain of a Bushman, and the one at the upper left is the brain of an European. Mark that while the brains of the apes differ

FIG. 40.—HAIR TRACTS ON ARMS OF MAN AND APE.

from one another, there is also a striking difference between the brain of the savage and that of the civilized man. Observe, too, how wonderfully these ape brains resemble the human brains, not alone in general form, but also in the number and depth of their convolutions. In fact, the brains of man-like apes and men consist of the same parts—the cerebrum, the cerebellum, the corpus callosum, and the hippocampus minor—and in both anthropoid and man the cortex of the brain is folded in essentially the same convolutions.

If any thoughtful person is still unconvinced of man's rise from ape-like ancestors, let him compare his mental image of some human beings he has seen with Fig. 43.

Consul II, a chimpanzee from Borneo, now in England, sits at the table, tucks his napkin under his chin, uses a knife and fork, drinks his tea from a cup, and has excellent table manners. After dinner, he sits back, lights his pipe, and enjoys a smoke. He washes himself with soap and water, dresses himself, shines shoes carefully, and, like a hotel waiter, expects a tip for his service. Another, and far more remarkable anthropoid, is Snooky, the educated chimpanzee who frequently appears in the "movies" in the Chester Comedies. Dressed like a man, this ape smokes a cigar, pretends to read a paper, poses as a chauffeur, rides a tricycle, takes care of

FIG. 41.—THE HEAD OF MISS JULIA PASTRANA.
(From a photograph by Hintze).

children, performs capers with boys, and takes various parts with men and women. So intelligent and humorous is the acting of this chimpanzee, so clever and human-like are its numerous performances, that it is justly advertised as the "humanzee."

In considering the relation between the anthropoid apes and men, we must not suppose that apes or ape-like creatures underwent a sudden transformation into human beings. The highest existing apes represent a development that preceded the appearance of man, some authorities think, by some two or three million years. The difference between these creatures and man is therefore the measure of life's upward rise by slow steps during that inconceivable time.

Man is related to the apes not alone in the structure of his body and brain, but also in the blood stream that courses through his veins. This has been conclusively proved by the remarkable series of blood tests conducted by Professor G. H. F. Nuttall at Cambridge University. By these tests, it was shown that man and the chimpanzee are blood relations; that the gorilla is a more distant relative, and the orang a relative more distant still. Below the anthropoids, the blood relationship is represented with diminishing force in the baboons and monkeys. These blood tests confirm the conclusions of zoology and prove the truth of evolution.

Fig. 44 is a picture of Haeckel's genealogical tree of humanity. It enables us to visualize in its main outline the history of the evolution of life. At the bottom of the tree are the monera and the amœbæ—tiny creatures consisting of a single cell. As growing life assumes diverse forms, the foremost creatures are represented by higher and higher positions on the trunk of the tree, or by diverging branches in the ascending order. Life is seen to progress from the simple to the complex, past the sponges, the molluscs and the fishes, through the amphibians, the reptiles, the marsupials, rising higher and higher in the scale of being, through lemurs, apes and anthropoids, until, at the topmost summit of the tree appears man.

And what has been the secret, the driving force back of this process of evolution? To understand the causes of evolution, it is necessary to understand the four fundamental laws of life. First, that while creatures resemble their parents through heredity, they nevertheless differ more or less from their parents—this is the law of variation. Secondly, that more creatures are born than can survive—this is the law of surplus population. Thirdly, that among living creatures, and owing largely to over-population, there is continually going on a struggle for existence—this is the law of struggle. And fourthly, that out of this struggle there results the survival of

the fittest. Variation, surplus population, struggle, spell the survival of the fittest. In the struggle for existence, those creatures possessing the best bodies and the keenest minds, those that could best protect themselves from their enemies and obtain their food—in a word, those that were best adapted to their environment—survived, while the others perished. Those whose variations were unfavorable, the weak, the inferior, died. But those whose variations were an advantage, the strong, the superior, survived. In consequence of the survival of the fittest, Nature, throughout the unfolding ages, kept breeding from the best. And this practice could have but one result—the gradual improvement of every race of creatures.

It will be well to elucidate somewhat the principles thus summarily stated. First, then, as to variation. The offspring is never exactly like its parents, and no two creatures are ever quite alike. The stems, the leaves, the blossoms of the plants of any species, the size and contour of their fruits, vary greatly. No two blades of grass, or ears of corn, or grains of wheat are alike. Every tree has an individuality of form. The young of dogs, cattle, horses, sheep, of fowls and birds, invariably differ from their parents in size and form, in coloring and character.

So, too, in a large assemblage of people, you will see noses and ears of numerous shapes and

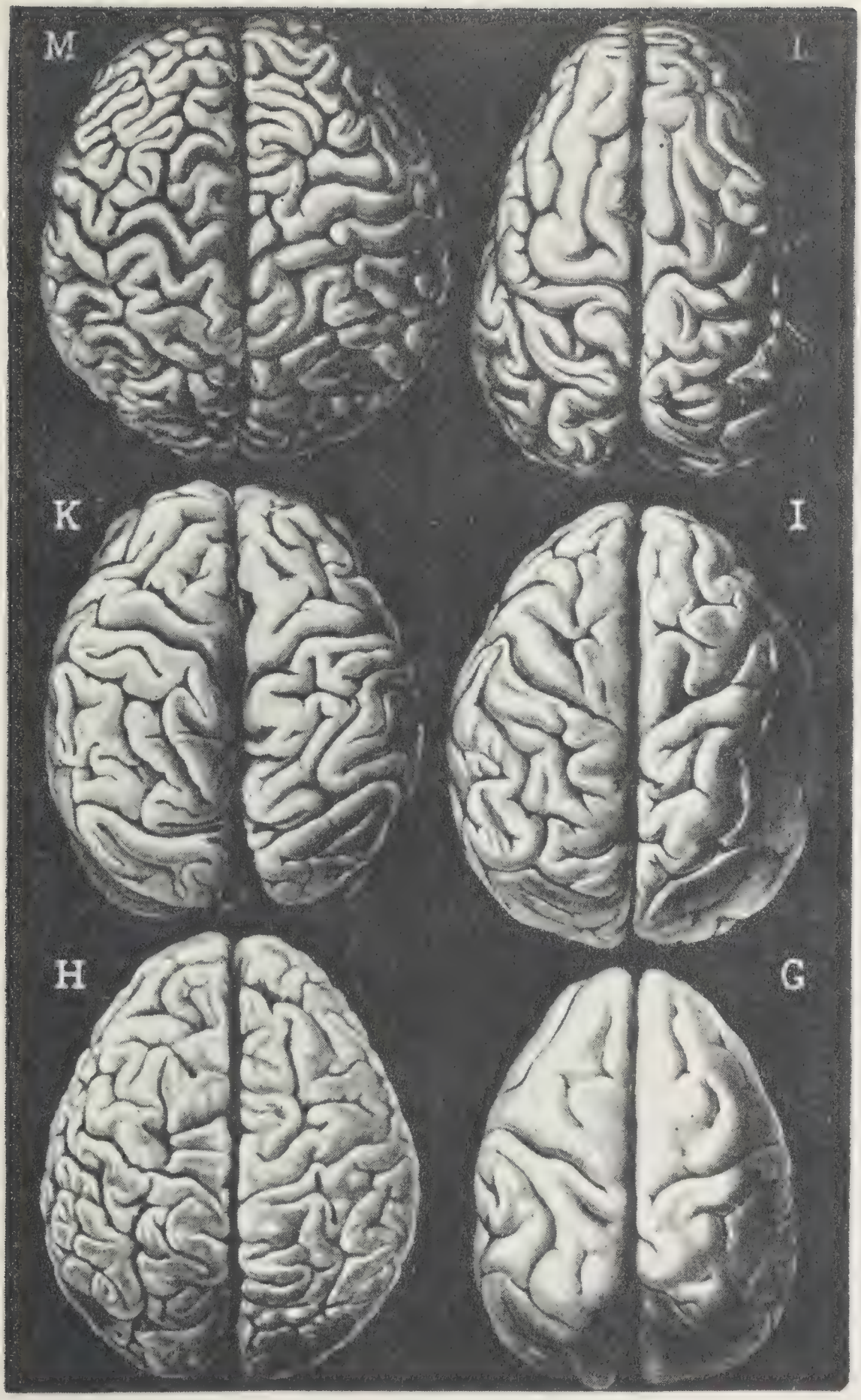

FIG. 42.—THE BRAINS OF ANTHROPOID APES AND MEN.

G-Gibbon. H-Chimpanzee. I-Orang. K-Gorilla. L-Bushman. M-Teuton. From Haeckel's "Evolution of Man."

sizes, eyes displaying a variety of coloration and expressiveness; you will observe that some foreheads are low and others high, some heads flat and others pointed, some round and others square; some men have long arms and legs, some the reverse; some have long bodies and short limbs, some the opposite; some have one ear, or shoulder, or hip, higher than the other, or are otherwise disproportioned. Moreover, great differences may be observed in the features of almost any family. The black haired mother has red haired daughters; the father's features are bequeathed to his sons except, perhaps, for the eyes of one or the nose of another. Variation is a basic law of life.

Secondly, as to the multiplication of creatures beyond the power of Nature to sustain them. Darwin, in the "Origin of Species" says: "There is no exception to the rule that every organic being naturally increases at so high a rate, that, if not destroyed, the earth would soon be covered by the progeny of a single pair. Even slow-breeding man has doubled in twenty-five years, and at this rate, in less than a thousand years, there would literally not be standing-room for his progeny."

On the fertility of the elephant, Darwin remarks: "The elephant is reckoned the slowest breeder of all known animals, and I have taken some pains to estimate its probable minimum rate of natural increase; it will be safest to assume

that it begins breeding when thirty years old, and goes on breeding till ninety years old, bringing forth six young in the interval, and surviving till one hundred years old; if this be true, after a period of from 740 to 750 years there would be nearly nineteen million elephants alive descended from the first pair."

An illustration from the opposite extreme of the animal world will show that the breeding propensities of the largest existing animal are rivalled by those of the smallest. "The aphis or plant louse," says Dr. D. Kerfoot Shute in "A First Book in Organic Evolution," "is so very prolific that it has been estimated that the tenth brood of one female alone would contain more ponderable matter than all the population of China,—estimating this population at five hundred millions."

The rabbits introduced into Australia, where they found conditions ideally favorable to their increase, have multiplied so exceedingly that they have become a veritable pest. In a brief period, the progeny of a few rabbits has multiplied into millions, and these creatures have become so destructive of agriculture that rabbit-killing parties are organized from time to time and tens of thousands of the animals are killed with sticks and stones, in open places, the object being to exterminate as many rabbits as possible in the interest of the farmers' crops.

In 1850, some enterprising citizens of Brooklyn

imported a hundred English sparrows and gave them to the free city air. A little later, New York City imported two hundred and twenty of the noisy birds and liberated them in the parks of the metropolis. Rochester imported one hundred of the birds, and Philadelphia, with generous public spirit, opened the bosom of brotherly love to one thousand of the little strangers whose perpetual chatter formed a striking contrast to the worshipful quiet dear to the heart of the Quaker City. In the parks, among the trees, and in the streets of these cities, the sparrows—at home everywhere—twittered and quarreled in their friendly way, and multiplied. In twenty-five years the children of these birds had spread over five hundred square miles. Ten years later they had flung their domain over fifteen thousand square miles, and men were beginning to doubt the wisdom of those who had invited them to our shores. Since then the ubiquitous sparrow has about completed the conquest of the continent. Darting like an arrow amongst horses' feet, or dodging hurrying automobiles, his legions are familiar sights among the traffic of busy streets. He builds his rude nest under the eaves of houses, and in the architectural pockets around the roofs of public buildings, and thrives and multiplies through his wary association with man. The phenomenal increase in the number of sparrows in North America during a period of seventy years has been due to the

FIG. 43.—JOE AND SALLIE AT HOME.

A Chimpanzee couple of Edward's Zoological Exhibition. From Dr. Paul Carus's "The Rise of Man." Courtesy of The Open Court Publishing Co.

gregarious habit of these birds and to the favorable character of the environment.

Some animals tend to multiply ten fold in a generation; some would multiply to a hundred fold, and others to ten thousand fold. Not only could the progeny of any land animal, if given the right of way, soon crowd the earth, but the fishes, under favorable conditions, would, in a short time, literally fill the sea. A million eggs are spawned by the cod-fish in order that two cod-fish may reach maturity. The eel also spawns millions of ova that a few eels may reach the spawning age. It is clear, therefore, that if all these eggs produced fishes, and if these reached maturity and in their turn multiplied with such lavish prodigality, a few generations would suffice to transform the ocean into a solid mass.

The same phenomenon obtains in the plant world. Every plant gives its seeds to the soil as Autumn's spendthrift hand gives its withered leaves to the wind, but of the millions of seeds thus scattered, comparatively few take root and mature and reproduce their kind.

Notwithstanding Nature's tremendous efforts to overwhelm the earth with the creatures of every species, the checks upon over-population are so numerous and so effective that, speaking generally, the number of animals and plants in any given area where the conditions are unchanging remains fairly constant. This relatively rigid

limitation of the number of creatures that shall survive in any environment is due to the operation of Nature's efficient machinery whose grim function is the destruction of life.

Millions of creatures live only by devouring other creatures. The carnivorous animals eat the flesh and drink the blood of the herbivorous. The larger carnivores feed upon the smaller. That the badger may make a meal, a whole nest of bees must be destroyed. The ant-eater swallows a tongue load of ants at a single gulp. The eagle and the hawk dine on doves and other birds. To the appetite of smaller birds are sacrificed worms, insects and larvae. Big fishes eat the little ones; bigger fishes eat the eaters and in turn are eaten. On land, in the air, and in the sea the incalculable sacrifice of life proceeds without cessation. Pursuit and flight, capture and death—a tragedy on which the curtain never falls!

This is the struggle for existence. In this struggle which, in a sense, is a constant test of skill, the most highly qualified creatures are the ones best adapted to catch their prey or to escape their enemies. Differing from their parents and from one another in numerous variations, some animals excel others in important respects—in having stronger legs with which to run, better eyes with which to see, a keener sense of smell, hearing more acute, and teeth and claws better fitted to hold and rend their prey. To the animal that

would obtain food or avoid being eaten, some or all of these characters are prime essentials. In the struggle for existence the animals possessing these attributes in superior form will survive while those in which they are less developed must perish.

Harmless creatures, no less than harmful, survive through favorable characters—some by the wit with which they elude the pursuer, some by flight, some by protective coloration; like the hare whose summer coat resembles the ground and whose winter garment rivals the whiteness of the snow, and the gorgeous butterfly, whose folded wings are a perfect simulation of the form and color of a dead leaf.

Where the herbivorous food was insufficient for the mouths that would feed upon it, and where animals devoured one another, it was inevitable that the weak, the stupid, the ill-favored, the incompetent, should fail in the struggle for existence, and that the strong, the cunning, the efficient should survive and hand their superior qualities to their offspring. And this survival of the fittest by right of might that has been the supreme law of the animal world since life appeared upon this globe, was bound to result in the accumulation of favorable variations, in the consequent production of an ever increasing wealth of species, and in the development of ever higher forms of life.

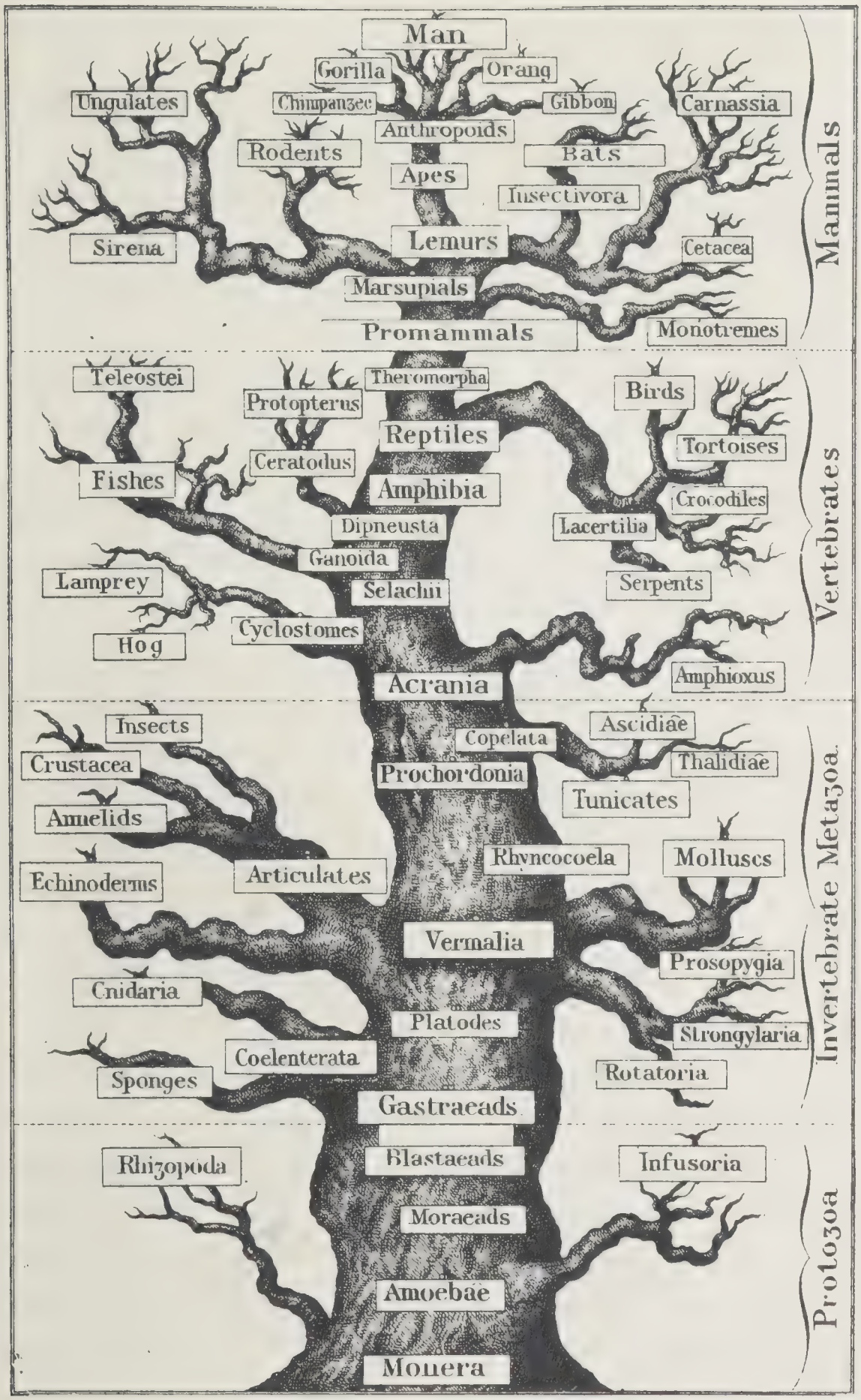

FIG. 44.—THE GENEALOGICAL TREE OF HUMANITY.

The fitness of the present forms has been moulded by the death dealing teeth of the past.

Though not by this means alone. Another potent factor that has wrought tremendously for evolution has been the changing environment. We may briefly consider the character of its work. For millions of years before the close of the Carboniferous period, some ten million years ago, the whole earth enjoyed a perpetual summer. During the last million years or more of that vast era, while the dense Carboniferous forests, overwhelmed again and again by the growing soil, were forming the coal deposits of the earth, many kinds of amphibians and low reptiles wandered over the marshes and among the trees.

Then in the succeeding period—the Permian—the climate began to be colder. For a hundred thousand years or thereby the cold increased. At last the summit of an ice age was reached, an some four million square miles of the earth's surface lay beneath a thick mantle of ice and snow. That ice sheet covered a continent that then extended from India to Australia, on the one hand, and to Africa on the other. The ice age, which was due, probably, to the gradual elevation of the land, wrought fearful havoc among the land animals, and with a ruthless hand pushed evolution forward. It compelled animals—and plants also—to change or die.

In the warm climate that preceded the ice age,

all animals were cold-blooded,—warm blood was not needed—and amphibians and reptiles left their eggs on the earth to be incubated by the genial air. But in the awful cold that followed warm blood was required, and, as the cold destroyed their eggs, it was necessary for animals to develop means of wooing their young to life within their bodies. Another required change was that the cold reptile covering be abandoned for a warm coat of hair.

Only a few animals could make these adjustments. Accordingly, as calculations based upon the fossils prevalent before and after the ice age have shown, "thirty-nine out of every forty of all the species of animals and plants on the earth during the coal forest age were destroyed." Of the animals that survived, some were saved by migrating to favorable regions, and some by adapting themselves to the rigors of the environment. These developed four-chambered hearts to keep their blood warm; they developed coats of hair or fur to retain the heat of their bodies; they made such changes in their internal economy as enabled the young to develop in the body of the mother.

To produce these changes, Nature preserved the favorable variations that appeared in different animals. From age to age these variations along advantageous lines were accumulated, and so, in time, the new creatures were evolved. The result was obtained through natural selection of the fit-

test. In this manner arose the mammals, and, through a variant line of development, the birds; for birds, like mammals, have four-chambered hearts, and feathers, like hair, are but a modification of primitive scales; while the bird hatches her eggs with the warmth of her body. So we may thank that early ice age for the gift of all mammalian and bird life. The originals of those animals whose development culminated in man, and of our feathered friends of the air, were fashioned by that incomparable sculptor—environment.

With the gradual passing of the Permian ice age, through the lowering of the land, the long backward spring slowly merged into another universal summer that continued for several million years. In this mild period, when Europe was, for the most part, a group of scattered islands, when a continent extended from America to Scotland, a new garment of multiformed vegetation appeared upon the low-lying earth; huge sharks and reptiles dominated the sea; while on the land, weird and prodigious monsters basked in the brilliant sun. It was the age when the giant reptiles,—some with sail-like wings, and all with frightful teeth—and ponderous vegetarians held the earth their own and led in the struggle for existence.

Then came another cold period, less drastic than the former, but severe enough to give a

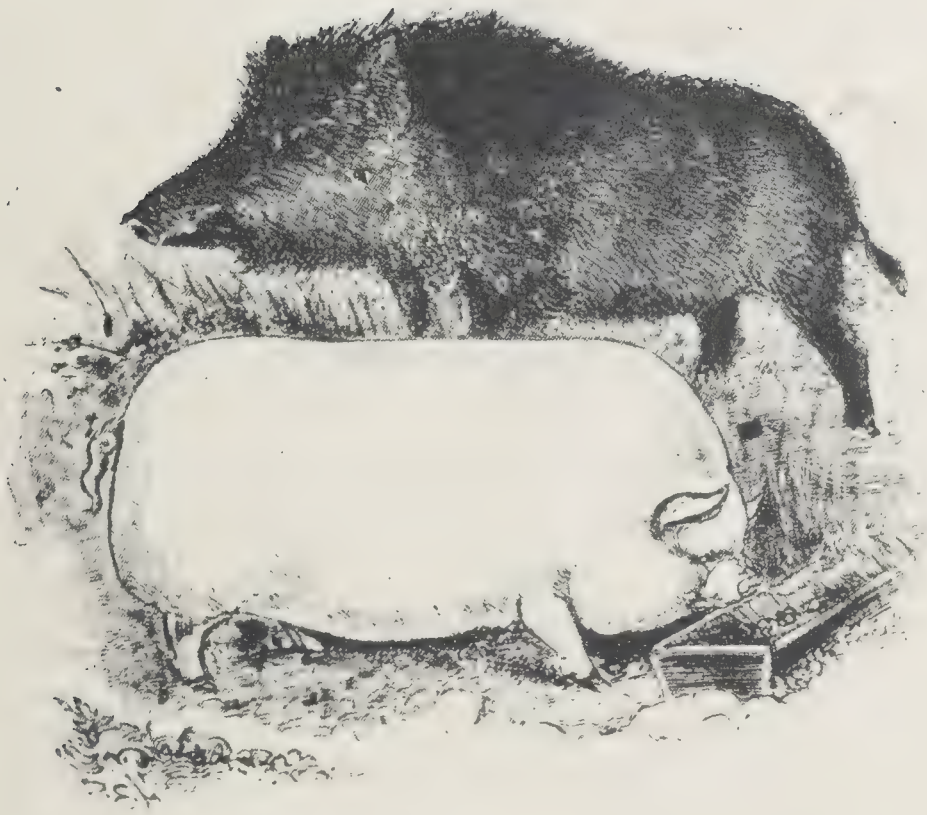

FIG. 45.—TWO PIGS.

signal forward urge to the work of evolution. The great reptiles disappeared forever. And now the primitive birds and mammals whose evolution had been retarded by their numerous enemies and by the climate in the warm reptilian age, entered upon a period of more rapid development. The bracing cold that required movement served as a stimulant to accelerate their evolution into various forms.

Since that remote time there have been several glacial periods—periods when great ice caps covered vast areas of the earth—periods whose tremendous cold was followed by ages when the climate was temperate and benign. These major changes in the environment, and the numberless other changes of less striking character, have been among the leading factors in the work of evolution.

Among the lesser, though important, environmental changes, may be mentioned the gradual submergence of land beneath the water, occasioning animal migrations which resulted in the mixing of stocks; the drying up of swampy regions bringing new plant life; changes in the food supply transforming animals into vegetarians or carnivores, or otherwise modifying their habits, and in consequence, their structure.

In these changes that have succeeded one another in the lapse of the innumerable ages, countless species of animals and plants have been

exterminated altogether; of others, only a few hardy or otherwise adapted specimens have survived; from these have been bred the animals and plants of the succeeding ages, which, in turn, have had to adapt themselves to their environment or disappear; and everywhere the struggle, whether with the environment or with other living things, has resulted in the survival of the fittest and the slow improvement of the fauna and the flora of the world.

The process of selecting the fittest to breed from, as it is carried on by Nature in her blind way, is called natural selection; and when men, in breeding stock, select the specimens possessing the most desirable variations to breed from, the process is named artificial selection.

The great variety of our domestic animals and plants we owe to artificial selection. Note, for example, the two pigs shown in Fig. 45. The grizzly one, the wild boar, is the remote ancestor of the other, the modern, favorite domestic porker. By breeding for many generations from pigs possessing the most desirable details of form, the legs and snout of the animal have been shortened, his body has been made more shapely and greatly enlarged, and his commercial value enormously increased.

Fig. 46 partially illustrates the diversity of dogs. The dog is a civilized wolf. And the pugs and poodles, the spaniels and setters, the

hairless dogs and hounds, the terriers and mastiffs, the faithful collies, the noble St. Bernards, and all the other dogs of every size and form, have been developed by selecting parents with approved variations and breeding for desirable results along chosen lines.

In like manner, the barnyard fowls have been developed by selective breeding. The Leghorns and Minorcas, with their beautiful combs and wattles, the Golden Spangled and the Silver Spangled Crested Hamburgs, with their crowning hoods, the noble Plymouth Rocks, with their barred bodies, the magnificent Light Brahmas and Buff Cochins, arrayed with wing-like feathery growths to their very toes, the game fowls of the various varieties—those sleek, trim birds that would rather fight than eat—and the little Bantams of every sort, proud and beautiful in their bearing—all these are the children of the rude jungle fowls whose male birds still shriek a welcome to the morning sun from the wilds of India and the Malay Islands.

Likewise, the hundred and fifty varieties of our pigeons—the graceful Modena, the large Runt, the tall Carrier, the Trumpeter with his strange coo, his hooded head, his winged legs, the Frill-back with his feathers curling towards his head, the Pouter, with his tall, slender body, and throat inflated as though a feathered football were pinched between his beak and breast, the

FIG. 46.—DOGS.

Reading from the top downwards: St. Bernard, Bloodhound, Greyhound, English Setter, Irish Spaniel, Dalmatian, Pug, Skye Terrior.

compact Fantail, leaning back with pride in his beautiful tail that rises above his head like a screen, the Tumbler, that from a lofty height tumbles with utter abandon through the air—all these pigeons, whatever their size, their form, their markings, their habits, have been developed during the last few centuries from the modest blue rock pigeons of the European coast (Fig. 47).

Such is the story that rounds the vast circumference of life. All life is one, and by the same means its varied ends have been attained. By breeding from those creatures whose qualifications enabled them to survive in their environment, Nature, without knowing why, selected the fittest to become the parents of the creatures that were to follow. Thus, of necessity, the life of the world, ever branching into an increasing diversity of species, gradually improved in form, function and intelligence. And with millions of ages in which to try every experiment, to test every detail, to destroy her failures and seek success along other lines, Nature was bound to reach our day with an array of living creatures of finer development than those that perished in the struggles of the vanished years.

The laws in accordance with which the humbler creatures have been developed from still lower forms have presided over the evolution of man from the beast; and, never pausing in their action, these forces have slowly fashioned the

FIG. 47.—PIGEONS.

Modena 10, Runt 19, Carrier 1, Trumpeter 4, Frill-back 37, Pouter 2, Fantail 6, Tumbler 15. Rock Doves in Centre.

glories of civilization from the dark crudity of savage thought. The story of man but continues in another form the story of life before man appeared.

The plant creations of Luther Burbank are renowned throughout the world. The Burbank potato, the Burbank rose, the new walnut trees, the varieties of plums and prunes, the pineapple quince, the spineless cactus, the everlasting flower, the beautiful lilies—the many new species of vegetables, plants, fruits and flowers which Burbank has created by crossing inferior forms and breeding from the best resulting specimens—these experimental triumphs in the plant world are indubitable proofs of the truth of evolution. Mr. Burbank has shown that plant life is not fixed in form, but plastic and ever-changing, and that by breeding and selecting in accordance with Nature's laws, man can cover the earth with new vegetables, fruits and flowers and vines and trees and grasses, more luxuriant and more wonderful than any found in an uncultivated condition.

Life, like clay, is malleable. Slowly, under the urge of Nature, rapidly in the hands of man, it shapes itself into new moulds. A problem in mathematics is known to be solved when it can be proved. In like manner, evolution is known to be certainly true, since, by following its laws, man now brings into the world new species of animals and plants that did not exist before.

A wonderful panorama is the story of evolution. From nebula to crusted earth, to life's first spark in the primal sea, to the myriad forms that fought with teeth and claws in forest wilds, to the fierce-browed creature that earth first knew as human, to the warmth of love and the glow of thought in the heart and brain of finished man, the forces of Nature have shaped existence and crowned it with the power of the human brain. Man the builder, so long the victim of ignorance and fear, may now shape his destinies in a world fashioned to his choice. The desert has been made to blossom like the rose; cities of solid masonry have arisen from the noisome swamp; industries supplying a thousand human wants now occupy the sites where wild beasts once filled the jungle with their savage roars; the ocean, earth and air have yielded to the conquering power of thought; invention, art, discovery, have tapped exhaustless stores of wealth and culture; literature, the press, schools, disseminate intelligence; and, rising above earth, man now solves the secrets of the stars and calculates with precision their changing movements. Man, Nature's gifted son, is Nature's conqueror! Let him then learn the means by which to further improve his life. Let him equip his mind with truth. Let him solve his problems in the light of knowledge and enjoy a rational existence in a well ordered world

Harry A. Fuller

W. Medford

Mass.